aquatherm

500 S 500 W | Lindon, UT | 84042 | 801.805.6657

support@aquatherm.com
www.aquatherm.com

This manual is designed to accompany the Aquatherm Installer Training Course and act as a reference for trained installers. It is not a substitute for taking the Installer Training Course.

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Aquatherm Installer Manual

For the proper installation of PP-R pipe and fittings manufactured exclusively by Aquatherm

Required for the Aquatherm Installer and Aquatherm Butt Welding Courses

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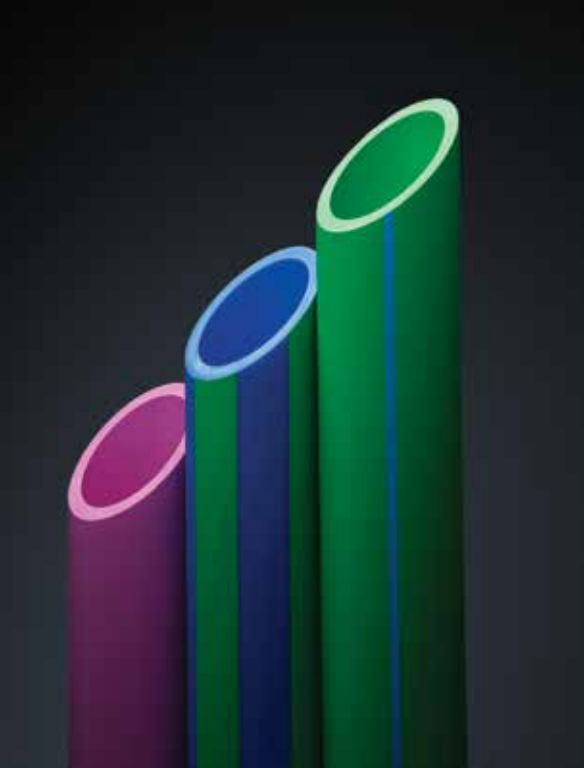


Chapter 1: Welcome to Aquatherm

This manual has been compiled to help ensure safe and consistent installation of Aquatherm's piping materials. Please read all instructions before beginning installation. Installers must take the appropriate training course from an authorized Aquatherm trainer before beginning installation.

This training will teach you the proper techniques for fast, reliable heat fusion connections and help you take full advantage of Aquatherm's many benefits.

Getting started

Before you get started, you should know a little about the pipe you are installing. Aquatherm's pipes and fittings are made from an engineered variation of polypropylene-random copolymer, or PP-R.

Aquatherm PP-R offers many benefits over metals and other plastics, such as durability, longevity, and chemical purity.

Aquatherm's polypropylene pipes and fittings are produced in Germany and have been used around the world for over four decades. The pipe and fittings are made to the highest international standards of quality, so you can trust the material every time you install it. If the pipe and fittings don't have Aquatherm labels, return them and don't install them. Only genuine Aquatherm products are protected by Aquatherm's warranty and decades of expertise with PP-R.

If you have not worked with Aquatherm's fusible pipe before, it is best not to rush and get ahead of yourself. Just as you were not able to make perfect welds your first day as an apprentice, it will also take you some time to become proficient at heat fusion. Fortunately, you'll find that learning fusion is quick and easy. This manual will act as your guide while you learn, and as you continue to fuse pipe for years to come.

Working with PP-R

Polypropylene is a thermoplastic, similar to polyethylene pipe. It is made from an oil by-product, so it naturally repels water. This makes it ideal for a piping material, as it does not affect, and is not affected by, the water it carries.

PP is made from chains of hydrogen and carbon, so there are no toxic chemicals that can affect drinking water.

PP-R is polypropylene copolymerized (combined) with a small amount of ethylene. This combination, enhanced by Aquatherm's proprietary formula, gives the material a balance of durability, rigidity and flexibility. PP-R is connected using heat fusion, which involves heating and cooling the pipe to join it to an identical material. This is covered in detail in Chapter 2.

All of Aquatherm's pipes and fittings are made from PP-R, so they will have the same properties. They can be heat fused together without any strength loss, and have the same densities, durability, and resistances.

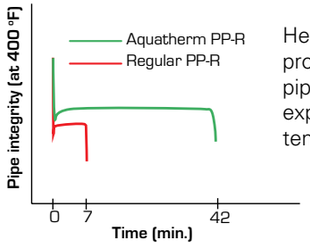
Aquatherm's PP-R has been engineered for improved performance and should not be mixed with other types of PP-R. PP-R should never be fused to PP, PVDF, PE, CPVC, or any other type of plastic. Never use solvent cements on Aquatherm's PP-R, as they may damage the pipe and won't bind properly.

Aquatherm innovations

Every piping material has advantages and disadvantages. PP-R is proven to have very few disadvantages, and several innovations unique to Aquatherm help address these minor shortfalls. Aquatherm's special blend of PP-R is called Fusiolen®, which is used in each Aquatherm pipe and fitting.

Normal plastic	VS	Aquatherm's Fusiolen PP-R
• Burns during fusion, resulting in strength loss • Damaged when exposed to high temperatures • Significant linear expansion when heated • Chemically reactive, resulting in failures		• Does not burn during fusion, for 100% strength • Heat-stabilized to withstand high temperatures • Multi-layer faser technology cuts expansion by 75% • Completely inert to water and most chemicals

The multi-layer faser composite (MF) process yields a mix of PP-R and glass fibers that reduces expansion but does not affect fusion properties.



Heat stabilization protects the pipe during brief exposure to extreme temperatures.

The world leader in PP-R pipe

Aquatherm is the world leader in PP-R pressure piping systems. When you work with our products, you have decades of research and experience backing you up. All Aquatherm products are thoroughly tested before, during, and after production by the best equipment and experts in the industry. This quality control helps ensure consistency in every Aquatherm pipe and fitting.

Aquatherm backs its products with a 10-year manufacturer's warranty that doesn't just cover replacement parts — it also covers the replacement labor, incidental damages, medical costs, and financial loss, giving you and your customers real peace of mind. Coverage begins upon submission of a successful pressure test record for the current coverage amount. Exact coverage amounts are subject to the exchange rate with the Euro at the time coverage is awarded.

PP-R is durable, both physically and chemically, and is more resilient against oils, freezing, impact, etc. than other plastics and even metals.

Proper care should be taken when working with Aquatherm pipes and fittings. The Aquatherm warranty does not cover damage caused by post-factory mishandling, jobsite abuse, UV damage, or improper installation. Full details of Aquatherm's warranty coverage can be found at Aquatherm.com/warranty.

Note: The Aquatherm warranty only applies to systems that are properly installed by an Aquatherm-trained installer. Improper installation or fusing to non-Fusiolen parts will void the warranty for those connections. Following all the procedures in this manual will minimize the risk of material failure and help ensure coverage in the event of a problem. Pressure testing is required to verify proper installation.

Material handling: Do

Inspect pipe upon receiving it. Aquatherm does not accept responsibility for damage that occurs after the pipe is shipped.

Don't fuse damaged pipe. Remove damaged sections and install the remaining pipe. Follow your distributor's policy for returns.

Keep the pipe on a flat surface or close supports to avoid bowing. Use at least 3 supports for 13' pipes and 4 for 19' pipes.

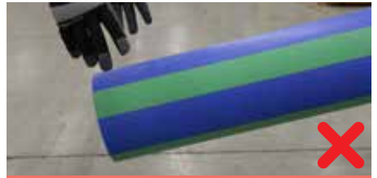
Keep the pipe in its protective bag or wrap until you are ready to install it. The bag protects the pipe from dirt, scratches, and UV rays.

Handle the pipe carefully, especially in freezing weather. Plastic may become brittle at cold temperatures, so treat it accordingly.

Cover unbagged pipe with a light-colored tarp if storing it outside. A dark tarp generates heat and may cause warping.

Material handling: Don't

Don't run over the pipe with any type of vehicle or crush the ends. This is the most common cause of pipe damage.



Don't drop the pipe or handle it roughly. PP-R can handle most impacts without issue, but there is no reason to risk damaging it.

Don't insert sharp or unpadded objects into the ends of the pipe. These can gouge the inside of the pipe and create weak spots.

Don't store pipe outside for more than 6 months uncovered. The pipe should be stored under a tarp or shade, or in its factory packaging.

Keep the fittings in their bags until you use them. Bagged fittings will be easier to identify and protected from contaminants.

Don't use damaged pipe that is gouged deeper than 10% of the wall thickness on the outside or 5% on the inside.

Pipe sizes

Aquatherm pipe is made to metric sizes (millimeters). This is part of its design and listings, but it is easy to learn the matching imperial sizes (inches).

This chart gives the matching sizes between metric and imperial. These sizes are based on factory settings and closest nominal diameters. Use the nominal size when switching from imperial pipe if gpm requirements are not available. Use the actual OD for sizing clamps and insulation.

Aquatherm pipes use standard dimension ratios (SDR) instead of schedules. This means that the wall thickness is proportional to the diameter of the pipe. From a performance standpoint, this makes the pressure rating of the pipe consistent through each size.

½" – 4" pipes come in 13 ft (4 meter) lengths.
6" – 24" pipes come in 19 ft (5.8 meter) lengths.

Socket fusion

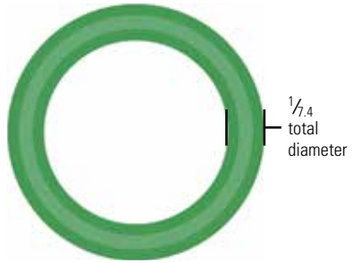
Factory metric OD	Nominal diameter
20 mm	½"
25 mm	¾"
32 mm	1"
40 mm	1 ¼"
50 mm	1 ½"
63 mm	2"
75 mm	2 ½"
90 mm	3"
110 mm	3 ½"
125 mm	4"

Butt welding

Factory metric OD	Nominal diameter
160 mm	6"
200 mm	8"
250 mm	10"
315 mm	12"
355 mm	14"
400 mm	16"
450 mm	18"
500 mm	20"
560 mm	22"
630 mm	24"

4" SDR 11 and SDR 17.6 may be butt welded.

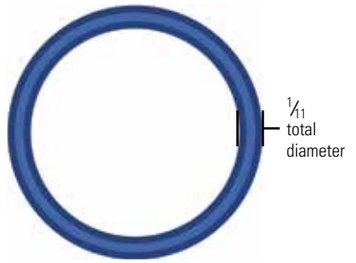
Wall thickness



SDR 7.4

A heavy wall provides increased pressure and temperature ratings for high-stress applications such as hot water system piping.

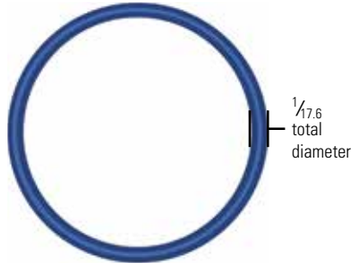
aquatherm green pipe® MF



SDR 11

A balanced wall thickness provides higher flow rates while maintaining high pressures. Suitable for most applications.

aquatherm green pipe® S
aquatherm blue pipe® MF
aquatherm lilac pipe® S



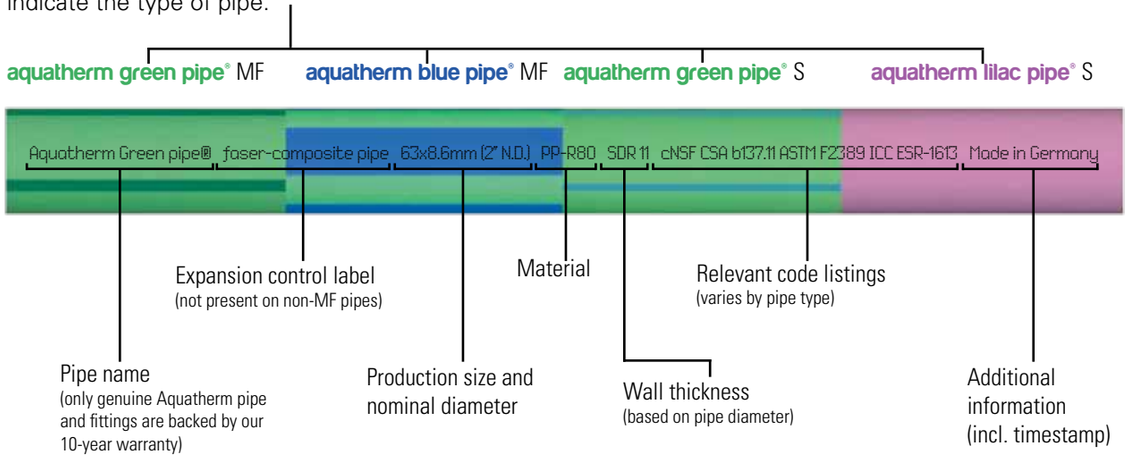
SDR 17.6

A thinner wall provides maximum flow rate while minimizing material weight, cost, and fusion times. For lower pressure systems such as chilled, cooling, or condenser applications.

aquatherm blue pipe® MF

Identification

Aquatherm has several lines of pipe that are specifically engineered for certain applications. Stripes and color indicate the type of pipe.


aquatherm green pipe® MF
aquatherm blue pipe® MF
aquatherm green pipe® S
aquatherm lilac pipe® S
Aquatherm Green pipe® faser-composite pipe 63x8.6mm (2" N.D.) PP-R80 SDR 11 cNSF CSA b137.11 ASTM F2389 ICC ESR-1613 Made in Germany
Pipe name
(only genuine Aquatherm pipe and fittings are backed by our 10-year warranty)
Expansion control label
(not present on non-MF pipes)
Production size and nominal diameter
Material
Wall thickness
(based on pipe diameter)
Relevant code listings
(varies by pipe type)
Additional information
(incl. timestamp)

Hot water aquatherm green pipe® MF

Color: Green

Stripes: Dark green

Wall thickness: SDR 7.4

Size range: ½" - 14"

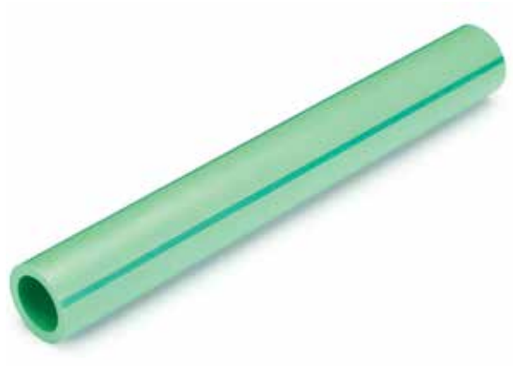
Multi-layer construction (expansion-controlled): Yes

Maximum operating pressure at 50 °F: 380 psi

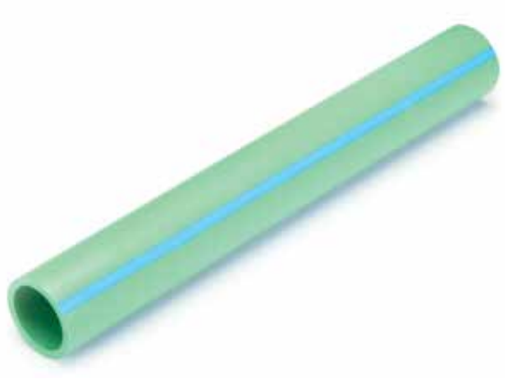
Maximum operating pressure at 180 °F: 100 psi

Recommended applications: Domestic (potable) hot water, food processing, light-hazard fire sprinkler (NFPA 13D)

Acceptable applications: Domestic (potable) cold water, heating, cooling, compressed air, chemical transport, and any other application suitable for PP-R



Cold water aquatherm green pipe® S



Color: Green

Stripes: Light blue

Wall thickness: SDR 11, 7.4 (¾" or smaller only)

Size range: ½" - 18"

Multi-layer construction (expansion-controlled): No

Maximum operating pressure at 50 °F: 195 psi

Maximum operating pressure at 140 °F: 95 psi

Recommended applications: Domestic (potable) cold water, food processing

Acceptable applications: Cooling, chemical transport, and any other lower temperature application suitable for PP-R

Thick-wall aquatherm blue pipe® MF

Color: Blue

Stripes: Green

Wall thickness: SDR 11, 7.4 (¾" or smaller only)

Size range: ½" - 18"

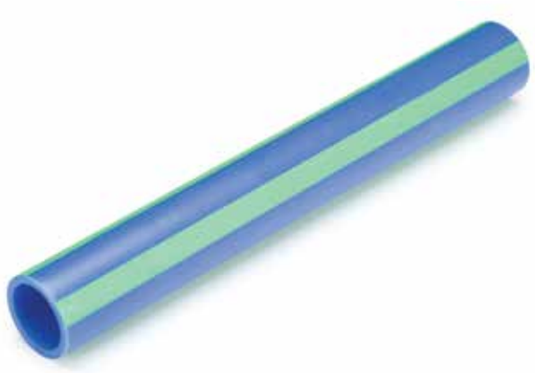
Multi-layer construction (expansion-controlled): Yes

Maximum operating pressure at 50 °F: 325 psi

Maximum operating pressure at 180 °F: 62 psi

Recommended applications: Heating and cooling distribution, compressed air, chemical transport, swimming pools (verify treatment levels), in-floor heating

Acceptable applications: Irrigation and any other non-potable piping applications



Thin-wall aquatherm blue pipe® MF

Color: Blue

Stripes: Green

Wall thickness: SDR 17.6

Size range: 4”- 24”

Multi-layer construction (expansion-controlled): Yes

Maximum operating pressure at 50 °F: 160 psi

Maximum operating pressure at 140 °F: 70 psi

Recommended applications: Geothermal, district cooling, low-pressure cooling distribution, condenser water piping to cooling towers

Acceptable applications: Any non-potable, low pressure, low temperature applications suitable for PP-R

aquatherm lilac pipe® S

Color: Purple

Stripes: None

Wall thickness: SDR 11

Size range: ½” - 10”

Multi-layer construction (expansion-controlled): No

Maximum operating pressure at 50 °F: 195 psi

Maximum operating pressure at 100 °F: 135 psi

Recommended applications: Rainwater, greywater, reclaimed water, irrigation

Molded fittings

- Single piece
- ½" - 4" fittings socket fuse over the pipe wall
- 6"- 24" fittings butt weld in-line with the pipe
- All pipes use the same PP-R fittings
- Minimal markings on the fittings
- Full labeling on the bag
- Keep fittings in their bags until ready for use
- Pressure rating meets or exceeds the pressure rating of the pipe

Segmented fittings

- Usually 2 - 4 fused pieces
- Butt weld in-line with the pipe
- 6" - 24" (elbows & tees)
- Made from **aquatherm green pipe**® or **aquatherm blue pipe**® to match piping system
- Size marked on label
- Stamped on the side to indicate origin
- **aquatherm green pipe**® fittings may be used with **aquatherm blue pipe** installations – do not use **aquatherm blue pipe** fittings in **aquatherm green pipe** installations
- Pressure rating meets the pressure rating of the pipe

Flow rates and sizing

For most applications, use the same size Aquatherm pipe as you use for other piping materials. The lower friction and higher flow speed of PP-R compensates for the smaller ID which occurs in some sizes. The following table gives the recommended GPM based on flow speed and head loss. The maximum GPM may be higher in some cases. Aquatherm pipe does not have internal corrosion or ID loss, so downsizing may be possible in some cases, at the discretion of the engineer.

Nominal diameter	GPM SDR 7.4	GPM SDR 11	GPM SDR 17.6
½"	6	8	-
¾"	9	12	-
1"	16	20	-
1 ¼"	24	32	-
1 ½"	40	50	-
2"	60	80	-
2 ½"	90	110	-
3"	130	160	-
3 ½"	190	240	-
4"	240	300	350

Nominal diameter	GPM SDR 7.4	GPM SDR 11	GPM SDR 17.6
6"	400	500	600
8"	800	1000	1100
10"	1200	1500	1800
12"	2400	3000	3400
14"	3000	3800	4500
16"	-	4500	5750
18"	-	6000	7250
20"	-	-	10000
22"	-	-	13000
24"	-	-	16000

Operating pressures

Systems with constant operating parameters (60-year expected minimum)

Temperature	aquatherm green pipe® aquatherm lilac pipe® SDR 11 (S)	aquatherm green pipe® SDR 7.4 (MF)	aquatherm blue pipe® SDR 11 (MF)	aquatherm blue pipe® SDR 17.6 (MF)
	Permissible working pressure (psi)			
50 °F	195	380	325	160
80 °F	170	320	255	125
100 °F	135	255	210	95
120 °F	110	215	180	80
140 °F	95	180	150	70
160 °F	-	120	100	45
180 °F	-	100	62	30
200 °F	-	45	30	15

This table assumes constant operation using water or a water/glycol mix. Seasonal operation or use of different mediums may impact the pressure rating of the pipe. Aquatherm pipe is not intended for use below -5 °F.

Compressed air

aquatherm green pipe® SDR 7.4 (MF)		aquatherm blue pipe® SDR 11 (MF)	
SDR	Pressure	SDR	Pressure
7.4	200	11	125
11	125	17.6	50

(assumes air temp < 100 °F)

aquatherm green pipe and aquatherm lilac pipe® weights and capacities

aquatherm green pipe® SDR 7.4 MF

Pipe ND	Capacity gal/ft	Weight lb/ft	w/water lb/ft
½"	0.01	0.11	0.22
¾"	0.02	0.17	0.34
1"	0.03	0.26	0.51
1 ¼"	0.05	0.41	0.83
1 ½"	0.08	0.64	1.31
2"	0.13	1.00	2.08
2 ½"	0.19	1.42	3.00
3"	0.27	2.03	4.28
3 ½"	0.40	3.04	6.37
4"	0.52	4.17	8.50
6"	0.85	6.54	13.62
8"	1.33	10.06	21.14
10"	2.08	15.74	33.07
12"	3.34	20.71	48.53
14"	4.24	26.29	61.61

aquatherm green pipe® pipe SDR 7.4 S / SDR 11 S
aquatherm lilac pipe® SDR 7.4 S / SDR 11 S

Pipe ND	Capacity gal/ft	Weight lb/ft	w/water lb/ft
½"	0.02	0.10	0.24
¾"	0.03	0.16	0.38
1"	0.04	0.18	0.51
1 ¼"	0.07	0.28	0.86
1 ½"	0.11	0.43	1.35
2"	0.17	0.68	2.10
2 ½"	0.24	0.95	2.95
3"	0.34	1.37	4.20
3 ½"	0.51	2.10	6.35
4"	0.66	2.63	8.13
6"	1.08	4.30	13.30
8"	1.70	6.70	20.86

Pipe ND	Capacity gal/ft	Weight lb/ft	w/water lb/ft
10"	2.65	10.42	32.49
12"	4.20	17.24	52.23
14"	5.34	20.99	65.47
16"	6.79	27.77	84.33
18"	8.57	35.15	106.54
The following items are supplied in coils			
½"	0.01	0.07	0.15
¾"	0.03	0.11	0.36
1"	0.04	0.17	0.50

aquatherm blue pipe® weights and capacities

aquatherm blue pipe® SDR 7.4 MF / SDR 11 MF

Pipe ND	Capacity gal/ft	Weight lb/ft	w/ water lb/ft
½"	0.01	0.11	0.22
¾"	0.02	0.16	0.36
1"	0.04	0.19	0.55
1 ¼"	0.07	0.29	0.85
1 ½"	0.11	0.45	1.32
2"	0.17	0.71	2.10
2 ½"	0.24	1.00	2.97
3"	0.34	1.44	4.30
3 ½"	0.51	2.13	6.39
4"	0.66	2.76	8.27
6"	1.08	4.51	13.52
8"	1.69	7.03	21.12
10"	2.65	10.93	32.97

Pipe ND	Capacity gal/ft	Weight lb/ft	w/ water lb/ft
12"	4.20	17.24	52.23
14"	5.39	22.16	67.03
16"	6.79	27.77	84.31
18"	8.57	35.15	106.56
The following items are supplied in coils			
½"	0.02	0.07	0.21
¾"	0.03	0.11	0.33
1"	0.04	0.17	0.53

aquatherm blue pipe® SDR 17.6 MF

Pipe ND	Capacity gal/ft	Weight lb/ft	w/ water lb/ft
4"	0.78	1.80	8.30
6"	1.27	2.92	13.52
8"	1.99	4.56	21.10
10"	3.11	7.09	32.95
12"	4.93	11.23	52.30
14"	6.27	14.23	66.43
16"	7.95	18.06	84.30
18"	10.07	22.82	106.69
20"	12.42	28.22	131.70
22"	15.60	32.25	162.16
24"	19.73	44.63	209.01

Aquatherm listings and approvals

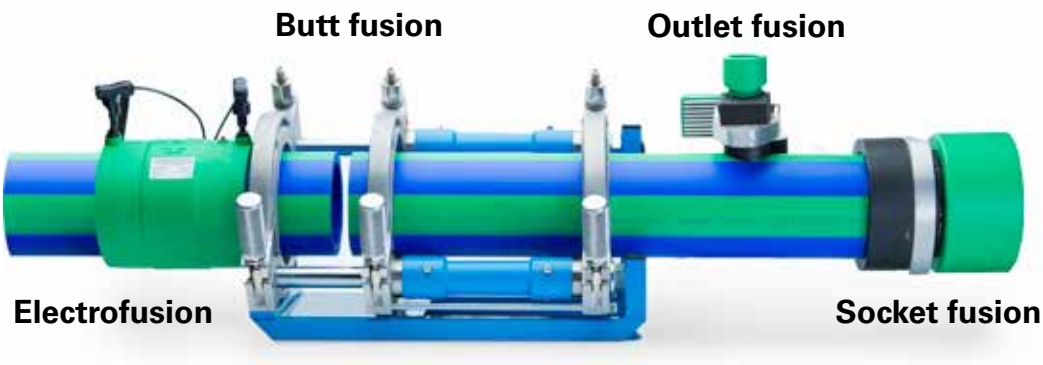
- NSF 14, 51 (Green Pipe only), 61 (Green Pipe only)
- CFIA A508 (Green Pipe only)
- ICC ESR-1613/PMG Listing 1014
- IPC 2009 Section 605 (Green Pipe, Lilac Pipe)
- IMC 2009 Chapter 12
- IRC 2009 Chapter 21 & 56
- UMC 2009 Chapter 12
- UPC 2012 Chapter 6 (Green Pipe, Lilac Pipe)
- IAPMO File M-6022
- IAPMO File 5053 (Green Pipe, Lilac Pipe)
- FM 1635 (Green Pipe 7.4 only)
- BNQ 3660-950 (Green Pipe only)

Reference standards

- CSA B137.11
- CSA B214
- ISO 15874
- ASTM F 2023
- ASTM D 635
- NFPA 13 D (Green Pipe 7.4 only)
- DIN EN ISO 14001
- DIN EN ISO 9001
- ASTM F 2389

Aquatherm is a rigid piping system, similar to copper and steel. Proper training helps ensure proper connections. Your own care and attention to detail will yield impressive results, whereas sloppy workmanship will yield poor results. This chapter will cover the basic techniques for heat fusing pipe.

Once you learn how to heat fuse, it will be up to you to provide the quality labor that makes each installation a work of art.



Safety

There are procedures that should be followed to work safely with Aquatherm pipe. These include:

Take proper precautions around electrical equipment and follow all instructions.

Follow Aquatherm-specific guidelines for proper material installation.

Wear OSHA-approved steel-toe shoes.

Wear a properly rated hard hat at all times.

Wear safety glasses.

Wear heat-resistant gloves while handling welding irons.

Be careful when handling hot irons.

Cutting the pipe: manual

These are recommended cutting methods, but you may use any method that doesn't damage the pipe. Cuts should be as square as possible (never more than 5° off) and without jagged edges. Check for longitudinal cracks on the pipe wall after each cut.

Use ratchet cutters with a sharp, pointed blade for smaller sizes. The pointed blade prevents the pipe from ovaling during the cut.

Don't use ratchet cutters with a dull or flat blade. Dull or flat blades can oval the pipe and cause it to crack.

Support the pipe while cutting to yield square ends and prevent bouncing or snapping.

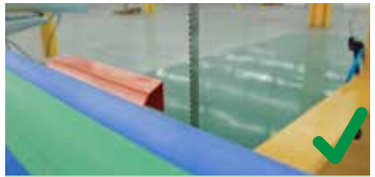
Use tube cutters with a wheel taller than the pipe wall. Smaller wheels might not reach through the entire pipe wall.

Hand saws are a safe alternative, even in cold weather. Dry chain saws can be used to cut larger pipe, but will produce a jagged face.

Cutting the pipe: power

⚠ When using hand saws, use plastic or metal-safe teeth. With powered saws, blades that are intended for hardwood will yield the best results. Avoid jagged or angled cuts, as these require additional prep to fuse. Don't use any tool or method that causes damage to the pipe.

Use a circular hardwood blade (60-100T) with carbide teeth. This will produce a cut that needs little to no clean-up.



Band and reciprocating saws are safe to use. The thinner blades leave a smooth cut, but you will also have some shavings to clean up.

A wide-toothed blade (24-40T) will produce a jagged cut that is rough and not desirable for socket fusion.

A fine-toothed blade (180T) will overheat the pipe, as will cutting too slowly. Make your cut as quickly and squarely as possible.

Don't use power cutters if the pipe is 40 °F or colder. Cold pipe can crack and split. Warm the pipe before cutting it.

Inspecting the cut

Upon receiving the pipe, and after cutting it, inspect the ends for cracks or damage. Mark and remove damaged sections, cutting a few inches past the damage. Fusing pipe that is cracked will result in joints that leak.

Remove any debris left from cutting the pipe. This is common with powered saws. Often, you can simply pull them out by hand. You may need to carefully cut them away with a blade or reaming tool.

Remove standing dirt and oil using an isopropyl alcohol-based cleaner (70% by volume or greater). Dirty pipe will not form proper beads during fusion. Be careful not to wipe off the printed label.

A good cut is smooth, square, and has no cracks or stress marks inside or outside the pipe.

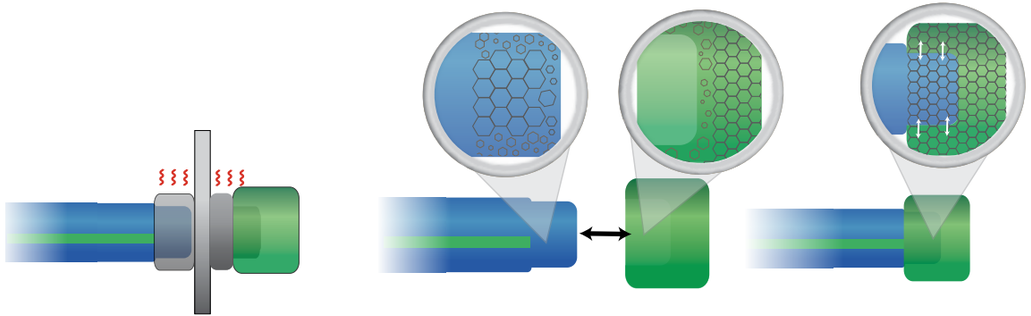
White stress marks and cracks indicate damage. Reassess any cutting tools that leave cracks. You may need to squeeze the end of the pipe to see small cracks.

How heat fusion works

PP-R plastic is made up of small chains of hydrogen and carbon. When cold, the chains are closed and won't react or bind with most common chemicals.

As the pipe is heated, the chains open and can be pressed together to form a connection. Pressure causes the chains to cross the gap, eliminating any leak path.

When they cool, the chains close again, forming a connection that is identical to the original material. This makes for a perfect connection with no foreign materials or leak path.



Socket fusion

In socket fusion, a fitting is fused over the outside of the pipe, leaving the inside open and unrestricted.

The fittings are sized to be too small to fit over the pipe unheated. This makes dry-fitting impossible, so connections cannot be accidentally left unfused. Also, the difference in diameter between the fitting and pipe creates the required pressure for fusion.

During socket fusion, the inside layer of the fitting is removed, as is the outside layer of the pipe.

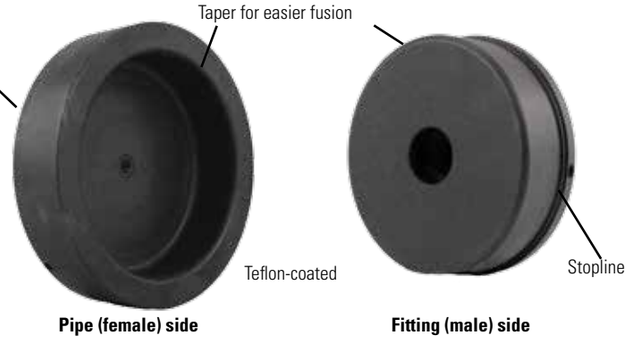
The heating process removes surface impurities and allows the pipe to be inserted into the fitting. The inner wall of the fitting fuses to the outer wall of the pipe, forming a bond that is stronger than the pipe wall itself. The connection forms on the entire fused surface.

Welding heads

Socket fusions are made using welding heads. Welding heads are specifically sized to match the pipe and fittings for a perfect fit. Different welding head sets are required for each size of pipe. Only use heads from an approved tool manufacturer.

Threaded bolt

Heads store inside each other to avoid scratches.



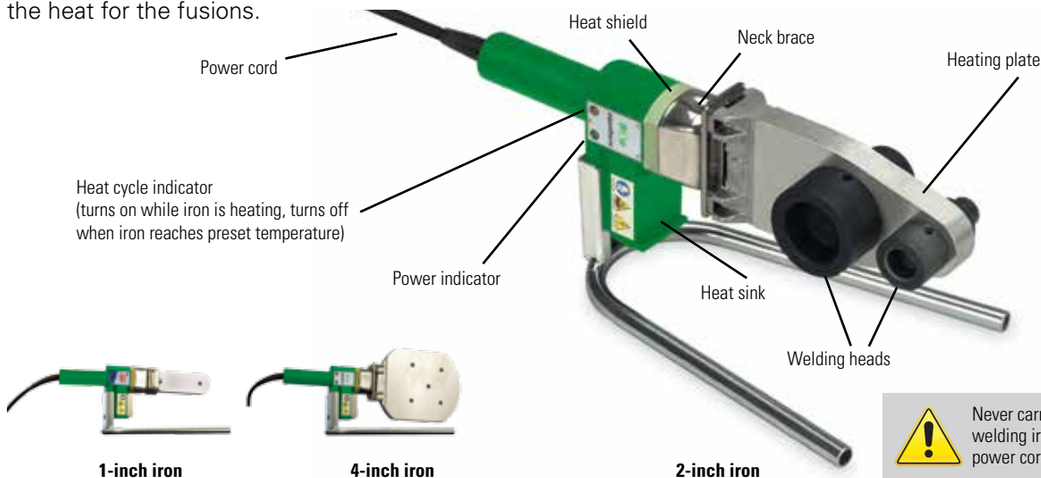
Pipe (female) side

Fitting (male) side

Before setting up the iron, clean the welding heads with rubbing alcohol or a similar non-corrosive agent if they are dirty.

Welding irons

The welding heads can be interchangeably attached to a welding iron, which provides the heat for the fusions.



1-inch iron

4-inch iron

2-inch iron

Never carry a welding iron by its power cord!

Welding iron safety : Do

Compared to open flames or noxious glues, a welding iron is fairly safe to use. However, the iron is hot enough to burn on contact and can remain hot for 30 minutes after it is unplugged. Take care in its use and handling. Never use water to cool an iron or head.

Wear heat-resistant gloves while handling the iron. Few gloves are heat-proof, so know the limitations of your gloves.

After use, return the iron to its case for storage. The case will protect the iron from impact and damage.

Post a sign near irons to warn that they are hot. Irons can remain hot for up to 30 minutes after being turned off.

Be aware of where other people are at all times while fusing. Make sure they are clear before you move the hot iron around.

Keep the cord away from the heat surfaces. Some cords are heat-resistant, but it's best to keep everything away from the heating surface.

Welding iron safety: Don't

Don't leave the iron unattended. Passers-by may not know if the iron is hot and could accidentally burn themselves.

Don't drop the iron or hold it by its cord. The cord is not intended to hold weight and dropping the irons may break them.

Don't touch the iron with bare hands unless you are certain the iron has cooled. Assume irons and heads are hot until tested.

Don't store multiple irons in a single box. Irons can easily damage each other and should be stored separately.

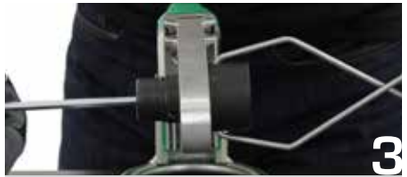
Don't let the iron touch flammable or meltable surfaces. This is a fire hazard and can damage the plate or heads.

Don't use the welding iron if the plate or heads are dirty. Clean the plate with a soft wire wheel and the heads with a cloth.

Tool assembly

Plug in the iron early, as it will take 5-10 minutes to heat up. Make sure that you have sufficient power for the iron. Low-gauge extension cords can be used to deliver power over long distances if needed. Be aware of other devices drawing power if you are using a limited power source, as this can cause fluctuations in temperature. Use a compatible power source for your iron. A surge protector will protect the iron from on-site power surges.

Set welding heads loosely in place while the iron heats up. The plate will expand as it heats and leave indentations if the heads are too tight.



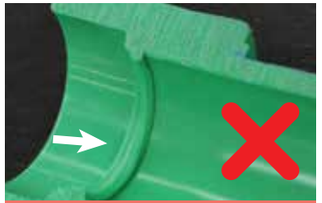
When the iron is hot, tighten the welding heads for full contact. Full contact will ensure uniform heating of the welding head.

Check the temperature using a digital thermometer. Test on the inside of the welding heads (at close range if using an infrared thermometer). The temperature for socket fusion should always be around 500 °F (+/- 18 °F). If the iron constantly cycles on and off, or if the heating phase takes a long time, there may be a power supply issue. If the iron does not reach 500 °F or exceeds it, the thermometer may be faulty. Use a contact thermometer if you are unsure.

Marking the pipe

The marking guide helps ensure proper insertion depth. The green marking guide (½" - 4") is ideal for smaller pipes and the blue marking guide is designed for larger pipes (2 - 4"). Marking on several sides can help you line up the connection.

Under-inserting will weaken the connection by reducing the amount of fusing surface.



Over-inserting will form a bead inside the fitting, causing a restriction in the pipe.

When using the blue marking guide, insert the fitting to the beginning of the mark, not the middle. The bead may roll over during fusion and cover the initial mark, so the tail shows that the pipe was properly marked upon inspection.

If the cut is slightly angled (but not enough to prohibit fusion), make only one mark on the long side. Use this mark to prevent over-insertion. Inserting to a mark on the shorter side will leave a partial bead in the pipe. Inserting to the long side will leave a slight internal gap, but this will not affect the connection strength.

Socket fusion heating and cooling times

Column A: Nominal diameter in inches
This is the size of standard pipe that the Aquatherm pipe normally replaces. In some cases, it may be possible to use a smaller diameter Aquatherm pipe based on flow rate.

Column B: Metric OD in mm
This is the manufactured size of the pipe.

Column C: Actual OD in inches
This is the actual size of the pipe in inches. Use this for sizing clamps and penetrations.

Column D: Welding depth in inches
This is the depth the pipe should be inserted into the socket fitting. Use this for planning the length of a cut and if no marker is available.

Column E: Heating time for normal weather
Usually 40 - 100 °F. Reduce this time slightly if working in extreme heat (100 °F+). Never use less than 80% of the heat time in these circumstances.

When using SDR 11 non-faser pipe in small sizes (½" & ¾"), reduce the observed time by 1 second to avoid overheating and collapsing the pipe wall. Insert the pipe into the fitting as quickly as possible.

Column F: Heating time for cold weather
For 40 °F or colder, use these times. You may also use these times if you are having a hard time inserting the pipe all the way into the fitting within the welding time (G) but be careful not to overheat the pipe.

Column G: Welding time
This is the window of time between removing the PP-R from the welding iron and inserting the pipe completely into the fitting before it cools. If you exceed this time, you risk having the connection cool off, which could cause an incomplete insertion. If you cannot fully insert the pipe into the fitting in this time, get another installer or a fusion machine to help you.

Column H: Cooling time
Pipe should not be pressurized or stressed during this time. You will need to fully immobilize the pipe for up to ¼ of this time while the connection sets.

Socket fusion heating and cooling times

Pipe diameter			Welding depth	Heating time in sec.		Welding time	Cooling time
ND (inch)	OD (mm)	Actual OD (inch)	inch	above 40 °F	below 40 °F	sec.	min.
A	B	C	D	E	F	G	H
½"	20	0.79	9/16" (14.5mm)	5	8	4	2
¾"	25	0.98	5/8" (16mm)	7	11	4	2
1"	32	1.26	11/16" (18mm)	8	12	6	4
1 ¼"	40	1.57	13/16" (20.5mm)	12	18	6	4
1 ½"	50	1.97	15/16" (23.5mm)	18	27	6	4
2"	63	2.48	1 1/16" (27.5mm)	24	36	8	6
2 ½"	75	2.95	1 3/16" (30mm)	30	45	8	8
3"	90	3.54	1 5/16" (33mm)	40	60	8	8
3 ½"	110	4.33	1 7/16" (37mm)	50	75	10	8
4"	125	4.92	1 9/16" (40mm)	60	90	10	8

Socket fusion instructions *(page 1 of 2)*

In socket fusion, you are heating the outside of the pipe and fusing it to the inside of the fitting. This creates a large joining surface with no leak path, so proper connections will never leak or blow off.

You must use the properly sized welding heads for a proper fusion. These heads are available through Aquatherm and approved tool manufacturers.

The heating times (column E or F) begin when the pipe and fitting are fully inserted onto the welding head.

Clean the pipe (if needed) and insert the pipe and fitting into the iron. Pushing both sides at the same time helps hold the iron steady.

Stop the pipe when you hit the mark (column D). Over-insertion will cause a restriction in the pipe and lower performance.

Stop the fitting when you reach the stopline (page 2.8). Tapered heads will offer little resistance until just before the stop.

Observe the heating time (column E or F). A bead will form and become shiny as the fusion nears readiness.

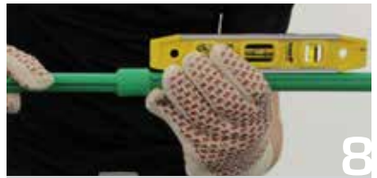
Socket fusion instructions *(page 2 of 2)*

Remove fitting and pipe from welding heads. Use a clamped stand or an extra hand to hold the iron in place.

Immediately* insert the pipe into the fitting. Push the pipe until the rings meet within the welding time (column G).

Do not touch the face of the pipe to the edge of the fitting. This flattens the beads and can cause an improper connection.

Once the rings meet, you will have 5 to 15 seconds to make adjustments to the alignment, depending on the pipe size. Do not twist during adjustment, alignment, or insertion.



Align the pipe and observe cooling time (column H). You will need to provide full support for at least ¼ of the cooling time.

*You will normally have 5-10 seconds to begin joining the connection after you remove it from the iron. This time will vary with pipe size and conditions. Waiting too long will let the pipe surface cool and make fusion impossible.

Large diameter socket fusion

Fusing pipe larger than 2" is difficult without help. There are several tips for assisted (two man) fusions:

- Increase the heating time by up to 50% if needed. It can take longer to fuse the pipe and fitting by hand, so overheating them makes the connection easier and prevents it from sticking midfusion. The ideal amount of overheating depends on the ambient temperature, the size of the pipe, and the strength of the installers. Use your best judgment to prevent the pipe from becoming too soft.
- Don't waste time. Once the pipe and fitting are removed from the iron, push them together immediately.
- PP-R doesn't burn while heating, so you can put the pipe and fitting back on the welding heads and start again if the connection is underheated. Pipes and fittings may be safely reheated once after the initial heating.
- Ensure that the pipe end is cut square and mark the pipe on several sides. This will help you line up the fitting squarely.

- If you can't push the pipe or fitting all the way onto the iron, allow the heat to melt the PP-R and then continue.
- Remember that the fitting welding heads are tapered; they will not offer much resistance until the fitting is almost entirely on.

Mechanically assisted fusions

For larger fittings, it is generally faster and more accurate to use a fusion machine. Fusion machines act as an additional set of hands during the fusion, aligning the pipe and fitting while providing a mechanical advantage.

There are many different types of fusion machines. Some lighter machines are easier to operate overhead, but may not offer additional support or have a fixed heating iron. Heavier bench-style machines offer increased stability and accuracy, but are less mobile.

Other fusion processes, such as butt welding and electrofusion, require special tools to complete them.

These, as well as the tools for socket fusion, are available from Aquatherm's approved tool manufacturers. These manufacturers supply properly sized tools for Aquatherm's piping systems and have an established history of providing excellent support to Aquatherm installers.

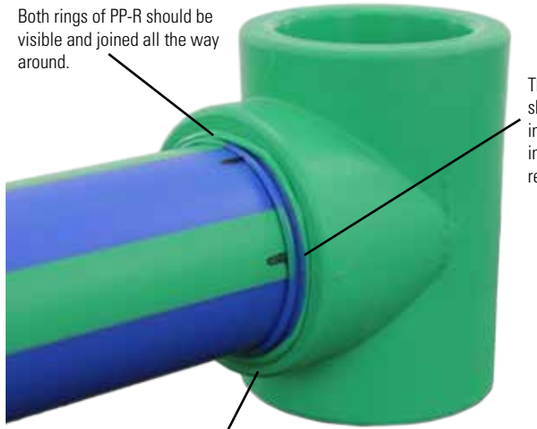
A complete list of these manufacturers can be found starting on page 2.36. Do not use fusion tools from an unapproved manufacturer.

Inspection

The following indicators will allow you to know that your connections have been performed properly. However, you will still need to do a pressure test to confirm the integrity of the joint.

Information on the pressure test can be found on page 4.40.

Certain fusion assistance machines have integrated depth controls. These controls should be used for their accuracy, but it is best to mark the pipe for inspection. Some machines will not bring rings completely together, but this is acceptable as long as the gap is consistent and the pipe reaches the inside of the fitting.


Both rings of PP-R should be visible and joined all the way around.
The edge of the mark should be visible to indicate that the proper insertion depth was reached.
The pipe should be square with the fitting. If intentionally angled, the angle per connection should not exceed 1 degree.

Avoiding improper fusions

Don't twist the fitting

Never twist a fusion connection. Twisting breaks the chains while they cool and will lead to a weakened connection. You may make some minor adjustments early in the cooling process, but avoid turning the fitting more than 2 degrees.

Prevent water contact

Like oil, PP-R is hydrophobic and repels water. Any water contact on the fusion area will cause the chains to close and prevent a proper fusion. Make sure the pipe is dry before beginning the fusion and that moisture cannot reach the fusion surfaces.

Use enough heat/Don't wait to fuse

Insufficient heat will cause the chains to close early, preventing a full connection. This can be caused by the iron being too cold, an extended delay after removing from the iron, or insufficient heat time. Make sure that you follow all the instructions while fusing and that your iron has sufficient power.

Troubleshooting bad connections

Pipe won't fully insert into fitting

- Welding heads are too cold → Make sure temp > 475 °F
- Extended delay after removing from iron → Fuse immediately after heat time
- Insufficient heating time → Increase heating time by up to 50%
- Fusion machine depth control is set to the wrong size → Double-check machine settings

Marks no longer visible/internal bead

- Over-insertion → Verify marking depth and stop just before the marks

Fitting does not look square

- Insufficient support during cooling → Hold pipe squarely for at least 25% of the cooling time
- Fitting was overheated → Reduce heating time slightly

The pipe sheets back instead of forming a bead

- Pipe too dirty for fusion → Clean pipe before fusing

No ring visible

- Only one side heated → Make sure both sides are heated

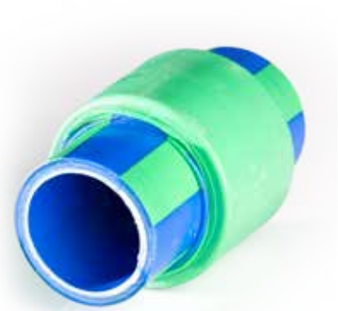
Ovality in machine-assisted fusions

The welding heads are designed to operate under very specific tolerances, and compressing the end of the fitting can prevent proper contact, and thus proper fusion. This is referred to as ovaling.

Ovaling occurs when the clamps of a fusion machine exert too much force on the mouth of a fitting and bend it out of round. To prevent this issue, avoid over-tightening the clamp that holds the front of the fitting. The clamps should be snug, but not so tight that they distort the fitting.

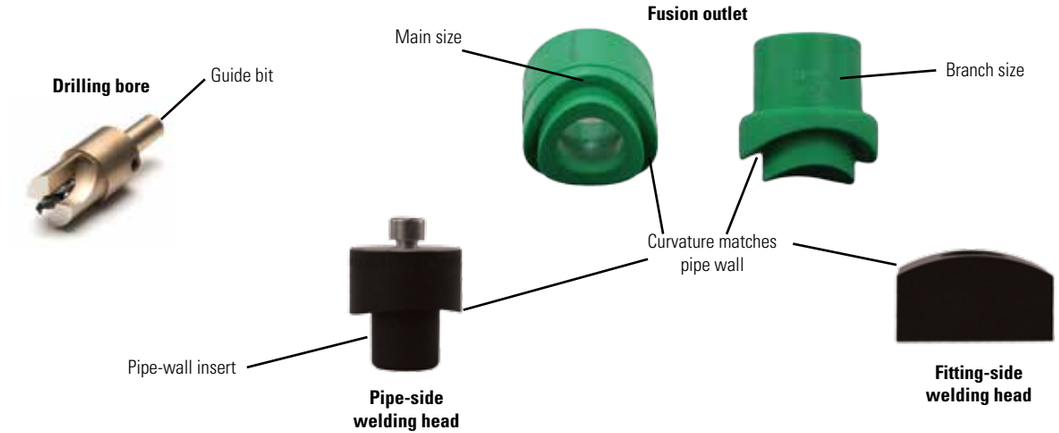
To prevent the fitting from slipping, use a backstop, or support the fitting with your hand during insertion. Giving the iron time to heat the pipe and fitting can also reduce the chances of slippage.

To determine if your machine and technique are causing ovaling, inspect the finished connection for two complete beads all the way around. If the beads are present on two sides, and absent on two sides, this may indicate that the fitting was ovaled during fusion. Ovaled fittings are not at full strength and may leak.



Fusion outlets

Using a technique similar to socket fusion, branches and outlets can be easily added to the walls of the pipe. This technique helps save time and money while providing flexibility for expansion following installation.



Fusion outlet instructions *(page 1 of 3)*

When drilling out a fusion outlet hole, there are two important things to remember:

1. Make sure to remove the material from the hole so it will not clog the main line.
2. The hole needs to be 1-3 mm (1/24" - 1/8") smaller than the OD of the branch line.

Aquatherm's boring tools are properly sized and designed to remove the shavings. The smaller bores use a hand-held drill with a 1/2" chuck. Bores over 2 inches require a drill press with a Morse Taper shank. You may also use hole saws or bores provided by other manufacturers, as long as they can cut a smooth, even, and properly-sized hole.

Getting a properly-sized hole is crititcal. An oversized hole will result in an incomplete fusion and cause leaks. An undersized hole will make it difficult to insert the welding head and can create a larger internal bead, reducing flow performance.

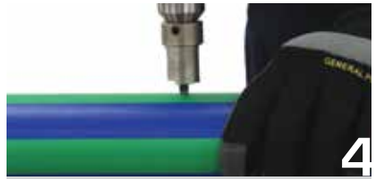
Set up the welding iron following normal socket procedures, found on page 2.16.

Don't forget to tighten the welding heads after the plate is hot and check the temperature before starting.

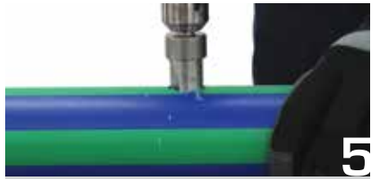
The welding head should not stick out past the iron. This will lead to uneven heat transfer and can prevent proper fusion.

Fusion outlet instructions *(page 2 of 3)*

Mark the pipe where you want the outlet. Once you begin drilling you cannot move the hole, so be sure of your placement.



Use the guide bit to start the hole to ensure accurate positioning. Drill at a right angle to the pipe. Quickly drill out the hole.



The bore should pull the shavings out so that they don't fall into the pipe. Clear away any excess debris. Flush any leftover shavings.

Insert the welding head into the hole and fitting into the head. Push down gently to keep the iron in contact with the PP-R.

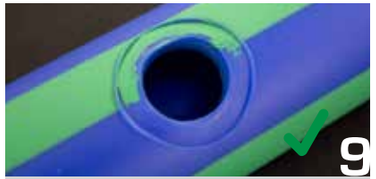
Rather than putting excessive force on the neck of the iron, you may use a dowel or a board to help push the iron into the pipe.

Pro tip:
For branches smaller than 2", don't use the fitting to push the iron into the pipe. This overheats the fitting. Instead, push the welding head into the pipe, and then set the fitting on the iron. For larger sizes, you may use the fitting to push the welding head into the pipe.

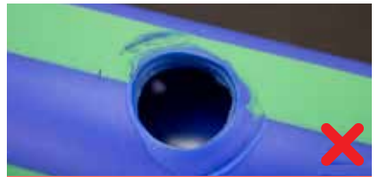
Fusion outlet instructions *(page 3 of 3)*

Pro tip:
Make sure the welding head you are using matches the pipe and fitting. In an emergency, it is possible to use a head with the wrong curvature, but you must have the right branch size. Tilting the welding head slightly from side to side can help ensure contact at all points.

Look for a bead to form around the fitting. This does not take much pressure. Too much pressure will cause internal restriction.



Ensure the welding head makes a full impression on the pipe. Check and adjust the head until the ring is complete.



If the welding head has not made a full impression, do not set the fusion outlet into the hole. It will not form a proper fusion.

Set the fitting in the hole and hold in place. Use only enough pressure to maintain contact between the heated surfaces.

Level and square the fitting as it cools. Like the socket fittings, you only have a few seconds before the fitting sets.

Electrofusion

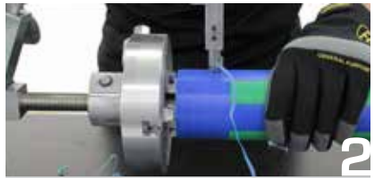
Electrofusion is another technique for fusing a socket onto a pipe. Rather than using contact heat, electrofusion uses electrical resistance heat from a copper coil inside the fitting. The fitting is attached to an electrofusion machine using a pair of leads, and a set voltage is applied to the coil for a set time. The time and voltage can be found on the label of the fitting. Electrofusion is particularly useful for situations where there is not enough space or mobility to perform a traditional socket fusion. However, electrofusion has more steps and is more difficult to visually inspect. Therefore, the choice to use electrofusion over traditional socket fusion depends on the physical restrictions of the installation and the installer's preferences. Electrofusions may be integrated with traditional socket fusion and butt welding if necessary.

Electrofusion machines are available from approved tool manufacturers.

It is best to plug in the machine and familiarize yourself with the controls and interface before beginning the electrofusion process.

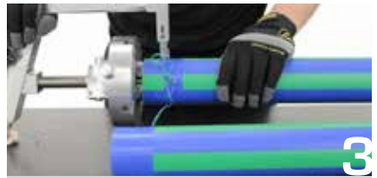
Electrofusion instructions *(page 1 of 3)*

Make sure the pipe is cut exactly square to ensure proper contact. Chamfer or ream the pipe to remove any rough edges.



Use a peeling tool or paint scraper to remove the outside of the pipe. Peel back at least half the length of the coupling being fused.

Pro tip:
Multiple passes may be necessary. Peeling tools are available from approved manufacturers. Make sure that you use metric or metric-compatible peelers. Avoid over-peeling the pipe. You can always make one more pass, but you cannot unpeel the pipe.

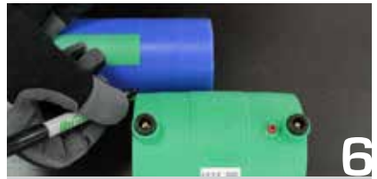


Repeat with the other pipe. If you are using the fitting as a slip coupling, peel one side back the entire length of the coupling.

Clean the outside of the pipes with an isopropyl alcohol wipe. Avoid touching those surfaces after cleaning them.

Don't open the fitting bag until you are ready to fuse the connection. This helps keep dirt off of the fusion surface.

Electrofusion instructions *(page 2 of 3)*



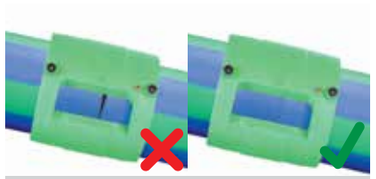
Mark the pipe at half the depth of the fitting. The two pipe sections will meet in the middle of the fitting.

Do not touch the peeled pipe or inside the fitting. Any oils, dirt, dust, or other contaminants may ruin the connection.

Insert pipe into the fitting. The pipes should fit snugly, but without any force. You should be able pull them apart.

Pro tip:
If the fitting cannot be pushed into the coupling without a significant amount of force, make another pass with the peeling tool. Remember to wipe the welding surface with rubbing alcohol, as the peeler may be dirty.

Attach the leads to the fitting. Most leads slide in with little resistance, so don't force them. Be careful not to bend them.



Make sure there is no gap in the middle. You won't be able to see the gap, so use your depth marks.

Electrofusion instructions *(page 3 of 3)*

Scan the tag on the fitting. Rescan if needed. On smaller couplings, the tag can be removed and laid flat for better reading.

Verify that the display matches the sticker. If the label and the machine don't match, rescan the fitting label or input manually.

Follow the directions on the machine. Verify your prep work and then begin heating upon confirmation.

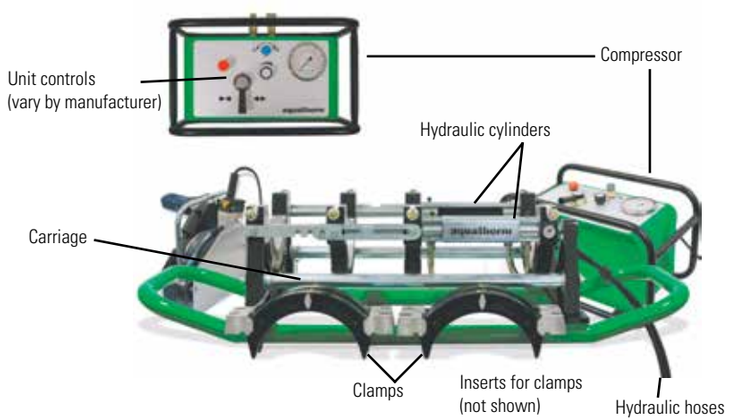
⚠ Make sure both sides of the pipe and fitting are fully supported for the entire fusion process. The fitting will become extremely soft after it is heated and will lose its shape if subject to any stresses.

Remove leads when heating is finished. The pipe and fitting will get hotter before cooling down again.

The black indicator on the top of the fitting will drop in after the connection is done heating, as long as the electrical leads are pointing up. You will only be able to verify the fusion during the pressure test. All electrofusion sockets are rated to 300 psi.

Butt welding

Butt welding is the process of using heat and pressure to join the faces of two pieces of pipe together. This eliminates the need for a socket-type fitting while maintaining the full strength of the connection. As with any fusion, the primary elements are heat and pressure. Therefore, a butt welding machine is designed to provide both, as well as support the pipe and prepare the pipe face for fusion.



Aquatherm supports butt welding on sizes 6" and larger on all SDRs as well as 4" on SDR 17.6 and 11. Installers may decide to butt weld smaller sizes at their own risk.

Explanation of butt welding

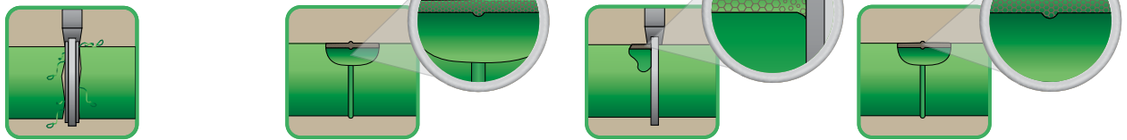
The basic steps to successful butt welding are: facing, adjusting, heating and fusing.

Facing: Facing is performed to square the ends of the pipe. In doing so, it also produces a contaminant-free surface on which the fusion will occur.

Adjusting: Building the adjustment bead against the iron ensures full contact of the pipe face and also sets the size of the resulting fusion bead.

Heating: Commonly referred to as the "heat soak", this step fills the PP-R with heat, energizing the molecules for fusion.

Fusing: Using the prescribed pressure, push the two pipe faces together and let them cool under pressure.



Butt welding pressures

Each phase of butt welding requires a specific pressure. The four pressures you will need to know are drag pressure, interfacial pressure, welding pressure, and full pressure. Calculate these pressures before starting your fusion.

Drag Pressure: Drag pressure is the minimum hydraulic pressure needed to overcome the carriage's inertia. You identify the drag pressure by slowly increasing the pressure control until the carriage begins to move. Drag pressure varies by machine design, machine orientation, and pipe size.

Interfacial pressure: Interfacial pressure is the force needed at the point of fusion to create a weld. Aquatherm PP-R butt welding always requires 14.5 pounds of pressure per square inch of surface area being fused.

Welding Pressure: Welding pressure is the force needed by the machine to achieve proper interfacial pressure. This varies by machine cylinder size and pipe dimension. Welding pressures are available from the manufacturer and are included in this manual as well. Welding pressure is measured by the machine's pressure gauge.

Full Pressure: The drag pressure and welding pressure are added together to create full pressure, which will be used twice during the fusion process. Full pressure should be set on the machine during your post-facing alignment inspection.

Butt welding phases

Each phase in the butt welding process takes the basic steps of facing, adjusting, heating and fusing and applies the previously calculated pressures to form a completed weld. Each phase has a required time or visual cue to let you know when that phase is done.

Facing Phase: The pressure for facing will vary based on the pipe size and condition of the blades. Starting at drag pressure, gradually increase the pressure between the pipe and the facing machine until two 360° continuous ribbons are removed from the pipe on both sides.

Adjustment Phase: This phase pushes the exposed pipe surface out of the connection by pressing the pipe face against the heating iron at full pressure. This phase is complete when the displaced material forms a visible bead (see page 2.44).

Heating Phase: During heating, the pipe remains in contact with the heating iron under low pressure. This allows the heat to soak into the pipe without displacing the PP-R material. Heating times (and all other reference times) can be found on pages 2.45 and 2.46.

Welding Phase: After removing the iron, the two heat-soaked pipe surfaces are brought together under full pressure. The pipes must be brought together within the transition time and brought to full pressure within the build-up time.

Cooling Phase: As the fusion occurs, keep the joint under full pressure for a minimum of half of the cooling time. After this, the joint may be removed from the jaws but must remain supported for the remainder of the cooling time. Unsupported pipe must remain under pressure for the full cooldown.

McElroy adjustment and welding pressures

McELROY
918-836-8611
fusion@mcelroy.com
www.mcelroy.com

Installers should always use the operator's manual included with the butt welding machine, or the manufacturer's online information, to calculate the adjustment pressure. This table is based on the information available to Aquatherm at the time of this manual's printing and may not be complete, accurate, or current. If there is a discrepancy between this table and any information provided by the tool manufacturer, the tool manufacturer's information shall be considered correct.

Dimension ND (OD mm)	SDR	Pitbull 26 15" Lever	28 Low Force	Acrobat 160	DM 250 EP	412 & 618 Low Force	824 & 1236 Low Force
		Adjustment pressure (psi)					
4" (125 x 7.1)	17.6	5 ft-lbs	34	66	-	-	-
4" (125 x 11.4)	11	8 ft-lbs	53	101	-	-	-
6" (160 x 9.1)	17.6	9 ft-lbs	60	108	60	32	-
6" (160 x 14.6)	11	14 ft-lbs	93	167	93	49	-
6" (160 x 21.9)	7.4	20 ft-lbs	132	236	132	70	-
8" (200 x 11.4)	17.6	-	94	-	94	50	17
8" (200 x 18.2)	11	-	145	-	145	77	26
8" (200 x 27.4)	7.4	-	207	-	207	109	36
10" (250 x 14.2)	17.6	-	-	-	142	78	26
10" (250 x 22.7)	11	-	-	-	218	120	40
10" (250 x 34.2)	7.4	-	-	-	309	170	56
12" (315 x 17.9)	17.6	-	-	-	-	124	41
12" (315 x 28.6)	11	-	-	-	-	191	63
12" (315 x 43.1)	7.4	-	-	-	-	270	90

McElroy adjustment and welding pressures

Dimension ND (OD mm)	SDR	412 & 618 Low Force	824 & 1236 Low Force
		Adjustment pressure (psi)	
14" (355 x 20.1)	17.6	157	52
14" (355 x 32.2)	11	242	81
14" (355 x 48.0)	7.4	343	114
16" (400 x 22.7)	17.6	199	66
16" (400 x 36.3)	11	308	102
18" (450 x 25.5)	17.6	252	84
18" (450 x 40.9)	11	389	129
20" (500 x 28.4)	17.6	-	104
22" (560 x 31.7)	17.6	-	130
24" (630 x 35.7)	17.6	-	164

Ritmo adjustment and welding pressure

863-679-8655
info@ritmoamerica.com
www.ritmoamerica.com

Installers should always use the operator's manual included with the butt welding machine, or the manufacturer's online information, to calculate the adjustment pressure. This table is based on the information available to Aquatherm at the time of this manual's printing and may not be complete, accurate, or current. If there is a discrepancy between this table and any information provided by the tool manufacturer, the tool manufacturer's information shall be considered correct.

Dimension ND (OD mm)	SDR	Gamma 160	Delta Dragon 160	Delta Dragon 250B	Delta Dragon 315B	Delta Dragon 355B
		[N]	Adjustment pressure (psi)			
4" (125 x 7.1)	17.6	263		-	-	-
4" (125 x 11.4)	11	407		-	-	-
6" (160 x 9.1)	17.6	431	247	116	102	44
6" (160 x 14.6)	11	667	392	189	160	73
6" (160 x 21.9)	7.4	950	551	276	232	102
8" (200 x 11.4)	17.6	-	-	189	160	73
8" (200 x 18.2)	11	-	-	290	261	102
8" (200 x 27.4)	7.4	-	-	421	363	160
10" (250 x 14.2)	17.6	-	-	305	261	102
10" (250 x 22.7)	11	-	-	464	406	160
10" (250 x 34.2)	7.4	-	-	653	566	232
12" (315 x 17.9)	17.6	-	-	-	406	174
12" (315 x 28.6)	11	-	-	-	638	261
12" (315 x 43.1)	7.4	-	-	-	914	377

Ritmo adjustment and welding pressure

Dimension ND (OD mm)	SDR	Delta Dragon 355B	Delta Dragon 500	Delta Dragon 630
		Adjustment pressure (psi)		
14" (355 x 20.1)	17.6	218	-	73
14" (355 x 32.2)	11	334	-	102
14" (355 x 48.0)	7.4	479	-	160
16" (400 x 22.7)	17.6	-	174	87
16" (400 x 36.3)	11	-	276	131
18" (450 x 25.5)	17.6	-	218	116
18" (450 x 40.9)	11	-	334	174
20" (500 x 28.4)	17.6	-	276	145
22" (560 x 31.7)	17.6	-	-	174
24" (630 x 35.7)	17.6	-	-	218

Rothenberger adjustment and welding pressure

ROTHENBERGER
pipetool technologies at work

800-545-7698
www.rothenberger-usa.com

Installers should always use the operator's manual included with the butt welding machine, or the manufacturer's online information, to calculate the adjustment pressure. This table is based on the information available to Aquatherm at the time of this manual's printing and may not be complete, accurate, or current. If there is a discrepancy between this table and any information provided by the tool manufacturer, the tool manufacturer's information shall be considered correct.

Dimension ND (OD mm)	SDR	ROWELD® P 160 Saniline	ROWELD® P 250 A	ROWELD® P 160 B	ROWELD® P 250 B & P355 B	ROWELD® P 500 B & P630 B
		Adjustment pressure (N)		Adjustment pressure (bar)		
4"	17.6	263	394	7.4	4.2	-
4"	11	407	610	11.5	6.5	-
4"	7.4	580	869	16.4	9.3	-
6"	17.6	431	431	12.2	6.9	-
6"	11	667	667	18.9	10.7	-
6"	7.4	-	950	26.9	15.2	-
8"	17.6	-	675	-	10.8	4.8
8"	11	-	1039	-	16.6	7.4
8"	7.4	-	-	-	23.7	10.5
10"	17.6	-	1052	-	16.8	7.4
10"	11	-	-	-	25.9	11.5
10"	7.4	-	-	-	37.0	16.4

Rothenberger adjustment and welding pressure

Dimension ND (OD mm)	SDR	ROWELD® P 250 B & P355 B	ROWELD® P 500 B & P630 B
		Adjustment pressure (bar)	
12"	17.6	26.7	11.8
12"	11	41.1	18.2
12"	7.4	58.8	26.1
14"	17.6	33.8	15.0
14"	11	52.2	23.1
14"	7.4	74.6	33.1
16"	17.6	-	19.0
16"	11	-	37.2
18"	17.6	-	24.1
18"	11	-	37.2
20"	17.6	-	29.7
22"	17.6	-	37.2
24"	17.6	-	47.2

Widos adjustment and welding pressures

678-376-4379
info@widoswelding.com
www.widoswelding.com

Installers should always use the operator's manual included with the butt welding machine, or the manufacturer's online information, to calculate the adjustment pressure. This table is based on the information available to Aquatherm at the time of this manual's printing and may not be complete, accurate, or current. If there is a discrepancy between this table and any information provided by the tool manufacturer, the tool manufacturer's information shall be considered correct.

Dimension ND (OD mm)	SDR	Maxiplast	WI 4400	WI 4600	WI 4900	WI 5100 & 5500	WI 6100
		lbs	Adjustment pressure (bar)				
4" (125 x 7.1)	17.6	58	11	6	-	-	-
4" (125 x 11.4)	11	89	17	8	-	-	-
6" (160 x 9.1)	17.6	94	18	9	8	-	-
6" (160 x 14.6)	11	145	27	13	12	-	-
6" (160 x 21.9)	7.4	207	39	19	17	-	-
8" (200 x 11.4)	17.6	-	-	13	12	5	-
8" (200 x 18.2)	11	-	-	20	18	8	-
8" (200 x 27.4)	7.4	-	-	29	26	11	-
10" (250 x 14.2)	17.6	-	-	21	18	8	-
10" (250 x 22.7)	11	-	-	32	28	12	-
10" (250 x 34.2)	7.4	-	-	45	40	17	-
12" (315 x 17.9)	17.6	-	-	-	29	12	10
12" (315 x 28.6)	11	-	-	-	44	19	15
12" (315 x 43.1)	7.4	-	-	-	62	26	*

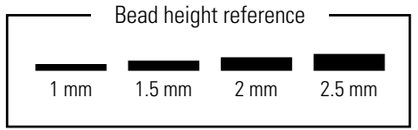
Widos adjustment and welding pressures

Dimension ND (OD mm)	SDR	WI 5100 & 5500	WI 6100
		Adjustment pressure (bar)	
14" (355 x 20.1)	17.6	15	13
14" (355 x 32.2)	11	24	19
14" (355 x 48.0)	7.4	37	*
16" (400 x 22.7)	17.6	20	16
16" (400 x 36.3)	11	30	24
18" (450 x 25.5)	17.6	25	20
18" (450 x 40.9)	11	38	31
20" (500 x 28.4)	17.6	30	25
22" (560 x 31.7)	17.6	-	31
24" (630 x 35.7)	17.6	-	39

* Contact manufacturer for pressure

Adjustment bead height *(4" - 24")*

Size	SDR 7.4	SDR 11	SDR 17.6
4" (125 mm)	-	0.04" (1.0 mm)	0.04" (1.0 mm)
6" (160 mm)	0.06" (1.5 mm)	0.04" (1.0 mm)	0.04" (1.0 mm)
8" (200 mm)	0.08" (2.0 mm)	0.04" (1.0 mm)	0.04" (1.0 mm)
10" (250 mm)	0.08" (2.0 mm)	0.06" (1.5 mm)	0.04" (1.0 mm)
12" (315 mm)	0.1" (2.5 mm)	0.08" (2.0 mm)	0.04" (1.0 mm)
14" (355 mm)	0.1" (2.5 mm)	0.08" (2.0 mm)	0.06" (1.5 mm)
16" (400 mm)	-	0.08" (2.0 mm)	0.06" (1.5 mm)
18" (450 mm)	-	0.1" (2.5 mm)	0.06" (1.5 mm)
20" (500 mm)	-	-	0.08" (2.0 mm)
22" (560 mm)	-	-	0.08" (2.0 mm)
24" (630 mm)	-	-	0.08" (2.0 mm)



The height of the bead is important during the fusion, as too small of a bead may lead to an improper connection, whereas too large of a bead can create a flow restriction and may also indicate a problem with fusion pressure. You will need to carefully watch the bead during the adjustment phase and reduce the pressure once the bead reaches its required height.

Remember that 1 mm is only 1/25th of an inch and is difficult to measure. Generally, when you can first see the bead, that is when it is at the 1 mm height. If your final bead (when the connection is all finished) looks too large, try reducing the size of your adjustment bead slightly.

Butt welding heating and cooling times *(4" - 12")*

Dimension		Heating	Welding (Fusion)		Cooling
ND (OD x Wall thickness in mm)	SDR	Heating time	Max. transition time	Time of pressure build-up	Cooling time
4" (125 x 11.4)	17.6	2 min. 56 sec	6 sec.	7 sec.	12 min.
4" (125 x 7.1)	11	3 min. 57 sec	7 sec.	11 sec.	19 min.
6" (160 x 9.1)	17.6	3 min. 24 sec.	6 sec.	9 sec.	15 min.
6" (160 x 14.6)	11	4 min. 37 sec.	8 sec.	13 sec.	24 min.
6" (160 x 21.9)	7.4	6 min. 1 sec.	10 sec.	19 sec.	34 min.
8" (200 x 11.4)	17.6	3 min. 57 sec.	7 sec.	11 sec.	19 min.
8" (200 x 18.2)	11	5 min. 20 sec.	9 sec.	16 sec.	29 min.
8" (200 x 27.4)	7.4	6 min. 52 sec.	11 sec.	23 sec.	42 min.
10" (250 x 14.2)	17.6	4 min. 32 sec.	8 sec.	13 sec.	23 min.
10" (250 x 22.7)	11	6 min. 8 sec.	10 sec.	20 sec.	35 min.
10" (250 x 34.2)	7.4	7 min. 46 sec.	13 sec.	30 sec.	52 min.
12" (315 x 17.9)	17.6	5 min. 17 sec.	9 sec.	16 sec.	28 min.
12" (315 x 28.6)	11	7 min.	12 sec.	24 sec.	44 min.
12" (315 x 43.1)	7.4	8 min. 40 sec.	15 sec.	37 sec.	62 min.

Butt welding heating and cooling times *(14" - 24")*

Dimension		Heating	Welding (Fusion)		Cooling
ND (OD x Wall thickness in mm)	SDR	Heating time	Max. transition time	Time of pressure build-up	Cooling time
14" (355 x 20.1)	17.6	5 min. 41 sec.	9 sec.	18 sec.	32 min.
14" (355 x 32.2)	11	7 min. 28 sec.	13 sec.	28 sec.	48 min.
14" (355 x 48.0)	7.4	9 min. 25 sec.	17 sec.	42 sec.	70 min.
16" (400 x 22.7)	17.6	6 min. 7 sec.	10 sec.	20 sec.	35 min.
16" (400 x 36.3)	11	8 min.	14 sec.	31 sec.	54 min.
18" (450 x 25.5)	17.6	6 min. 35 sec.	11 sec.	22 sec.	39 min.
18" (450 x 40.9)	11	8 min. 28 sec.	15 sec.	36 sec.	59 min.
20" (500 x 28.4)	17.6	6 min. 59 sec.	12 sec	24 sec	43 min.
22" (560 x 31.7)	17.6	7 min. 24 sec.	12 sec.	27 sec.	48 min.
24" (630 x 35.7)	17.6	7 min. 55 sec.	14 sec.	31 sec.	53 min.

Butt welding instructions: *1. Setup*

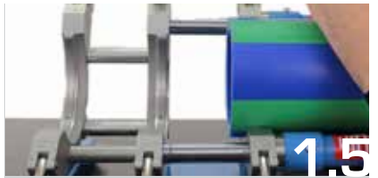
Set up and inspect the machine. Follow all of the manufacturer's directions. Perform any maintenance if needed.

⚠ Maintenance should only be performed by trained persons, the manufacturer or authorized dealer. Only refill the hydraulic oil according to the manufacturer's specifications. Make sure that your power supply is fully compatible with the machine you are using.

Check and tighten seals if needed. Release any air bubbles by bringing the machine to full pressure and slowly releasing it.

Inspect welding iron and turn it on. Make sure that the iron is clean and set to 410 °F (210 °C) +/- 18 °F.

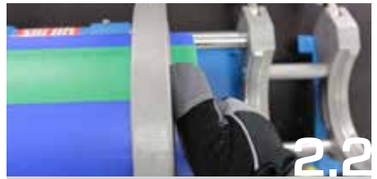
Set in the correct metric inserts, if needed. The manufacturer will know which clamps and inserts are compatible.



Cut the pipe at least 1/2" longer than your intended final length, or longer if your cut is not perfectly square.

Butt welding instructions: *2. Alignment*

Set pipe and/or fitting into the clamps. If possible, use at least 2 clamps for each pipe length. Adjust configuration as needed.



Leave a lip of 1/2" - 1" (more if cut is uneven). A thumb's width is normally a good measurement. Leave enough room for the facer.

Reposition clamps to accommodate fittings if needed. Some clamps slide and others can be removed entirely.

Tighten clamps and bring the pipe ends together. Make sure all hands are clear of the carriage while it is in motion.

Check alignment of pipe by running your finger or the end of a pen across the gap. If one side is higher than the other, tighten it down.

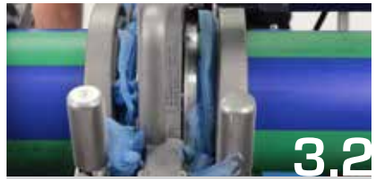
Drag Pressure: Find the drag pressure by increasing the pressure control until the carriage beings to move. Drag pressure varies by machine design and orientation, and pipe size.

Welding Pressure: Look up the welding pressure in the operating manual (or in this book if no manual is available). Welding pressure varies by OD and SDR.

Full Pressure: Add the drag and welding pressures to get the full pressure.

Butt welding instructions: *3. Facing*

Open the carriage set and lock in facing tool. Turn on facer and let it reach full speed. Never turn on the facer if it is pinched between pipes.



Close pipes on facer. Increase the pressure until the facer begins shaving off ribbons of PP-R. Don't use excessive pressure.

Drive the carriage forward whenever the pressure drops or the facer stops facing. Replace the blades if they are too dull.

Pro tip:
If one side begins facing before the other one, try opening and closing the jaws again to give the facer a "bump." You can also try inserting wood blocks between the clamps and the planing tool in order to force the facer to shave the opposite side. Facing to a pre-marked point can ensure proper length of the finished connection.

Proper facing will produce 360°, full-width strips on both sides. At this point, open pipes. Adjust the facer if one side is ready before the other.

Switch off and remove facer. Don't turn off the facer while the carriage is still closed, as this can leave nicks on the pipe face.

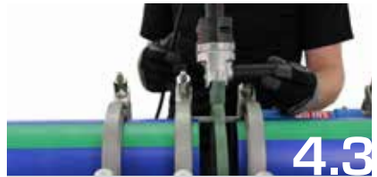
Butt welding instructions: *4. Adjustment*

Close carriage and check for gaps. Reface or realign if needed. Wipe down the pipe face with rubbing alcohol.

Pro tip:

Make sure that the two pieces being connected are still approximately 1/4" longer than your desired final length. You will lose roughly 1/8" off each side of the connection during the adjustment and welding phases. Measure and track your average loss to increase accuracy.

Set your max pressure level (welding + drag). Controls vary by manufacturer. Don't change this pressure after setting it.



Open carriage and insert the heating iron. Make sure your heating iron is at or near 410 °F (210 °C).

Close the pipes onto the heating iron under full pressure to initiate construction of the adjustment bead.

Build your adjustment bead to the specified height. The guide is on page 2.44. Do not let your bead get larger than required.

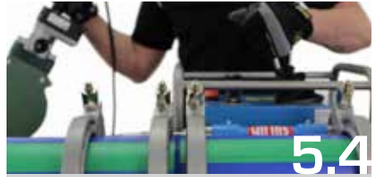
Butt welding instructions: *5. Welding*

Adjustment bead complete, drop the system to drag pressure. If necessary to maintain contact, add up to 10% of welding pressure.

⚠ The heating phase requires as little pressure as possible. Some machines lock in place only requiring the drag pressure. Others require a slight positive pressure to keep them in place, but never more than drag + 10% welding pressure. Excessive pressure during the heating phase can create a restriction in the pipe.

Observe the entire heating time (use a timer). Too little time will create an improper connection. Do not exceed the heating time.

Open carriage and remove iron. Make sure you have a safe place to set it down immediately if you can't hold it in one hand.

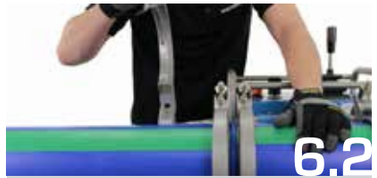


Bring pipes together within the transition time and ensure the machine achieves full pressure within the pressure build-up time.

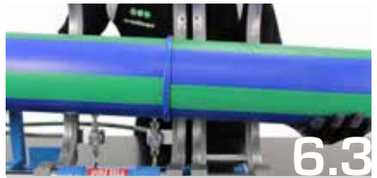
Butt welding instructions: *6. Cooling*

Observe the full cooling time. Do not try and shorten the cooling time by pouring water on the connection.

The final bead should look like one solid piece. A bad PP-R fusion will have a split bead with two distinct sides.



Release pressure and undo clamps. Don't loosen the clamps until pressure has been fully released.

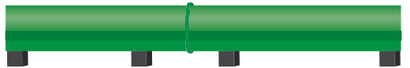


Remove the connection from the machine. Remember to keep the pipe supported if you have reduced the cooling time.

⚠ The cooling time can vary with the size and support of the pipe being fused. Short sections and long sections that are properly supported can use a reduced cooling time. Long sections that are not supported must use the full time. A visual guide can be found on the next page.

Reducing cooling times

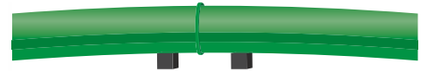
Butt welded connections need to cool under pressure to ensure a proper connection. Cooling times for butt-welded connections can be reduced by up to 50% if the joint is properly supported for the remainder of the cooling time. For example, the cooling time for 6" SDR 11 pipe can be reduced from 24 minutes to 12 minutes if the joint is not subjected to any undue stress for the remaining 12 minutes. The following images show proper and improper support for the pipe.



Whether on hangers or blocks, the pipe should be supported on either side of the connection, as well as further down the line to prevent deflection.

The pipe can also lay flat on the ground or a similar level surface.

Failure to support the pipe near the connection can result in undue stress on the bottom of the joint.



Failure to support the pipe further away from the connection can result in undue stress at the top of the joint.

Failure to support the pipe on both sides of the connection can cause undue stress across the joint.

Fusing dissimilar SDRs

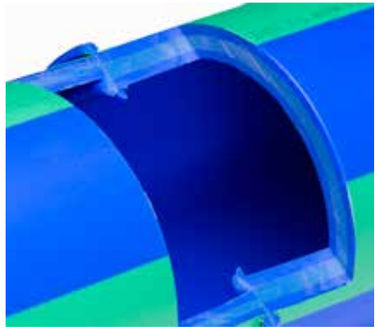
In order to fuse pipes with different SDRs, you will need to make the following modifications to your fusion process:

1. Use the heat time from the lower SDR (thicker wall) pipe or fitting.
2. Use the pressure from the higher SDR (thinner wall) pipe or fitting.
3. Use the average bead height of the two SDRs.

The external bead should appear normal. The internal bead will appear lop-sided, but this is not an issue. **The system will have the pressure rating of the highest SDR (thinnest wall) material that is fused into the section.**

As a general rule, you should avoid butt fusing different SDRs unless it is necessary.

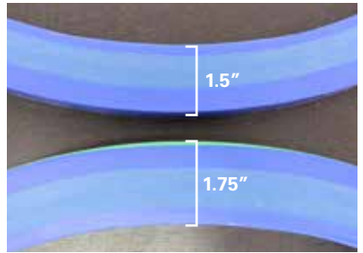
You should never attempt to butt fuse pipes with different ODs.

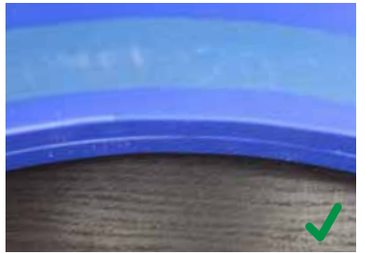


Internal alignment

Due to gravity and the physics of extrusion, larger pipes tend to be slightly thicker on the bottom than they are on the top. However, the top will always be at least as thick as the production SDR, so there is no concern over pressure and temperature ratings.

This difference is not enough to cause problems with the flow calculations or to require a change in fusion pressures. The only concern is simply an aesthetic one, where the internal bead will be misshapen if a thinner top is fused to a thicker bottom. To avoid this, line up the tops and bottoms of the pipe before fusing them. The easiest way to align the pipes is using the printed label on the side, as the label is always in the same relative position to the top of the pipe. Aligning the labels will help eliminate internal misalignment. If aligning the labels does not fix this issue, use your best judgment when aligning the pipe. The issue does not affect the outer wall of the pipe, which will always be consistent.





Repairs

For small holes in the pipe, such as holes from nails or screws, you can use the repair pin shown here. For larger holes, install and cap an outlet or remove the pipe and fuse in a new section.

Attach the repair head to a welding iron. Heads are available in 5/16" and 7/16" sizes. Use a size that is larger than the hole.

If the hole is too small, carefully drill it out. Use a 1/4" bit for the 5/16" head, and a 3/8" bit for the 7/16" head.

Insert the repair head into the iron and insert the repair pin into the repair head. Heat for 5 seconds.

Remove the pin from the head and the welding head from the pipe. Insert the pin into the pipe wall. Do not overinsert the pin.

Once the pin has set, you may use cutters to remove the rest of the pin. Pressure test the system to ensure a proper repair.

Chapter 3: Productivity

Heat fusion is a fast and consistent way to join pipe, but overall productivity depends on the build strategy being used.

Having the right crew and tooling mix will greatly increase the speed of your installation. Proper prefabrication and field techniques can help you work even faster. This chapter will help you apply the fusion techniques you've learned in faster, more productive ways.

Getting started

There are several unique features of Aquatherm pipe that can help you accelerate your install times.

- **Fusion outlets** allow you to add branches after installing mains
- **Lightweight material** is easier to carry in large amounts
- **Reduced contraction and expansion** makes layout easier
- **Fused joints** won't crack during transport
- **Flexible pipe** can be fed into tight spaces
- **Fusion machines** allow a single installer to work on multiple connections at one time

For each part of the installation, you should decide what sections to build in a shop or on a workbench (prefab) and which sections need to be built in place. Prefabrication gives you access to a wider range of fusion tools and makes it easier to work with multiple tools. In general, prefabricated joints are also faster and more accurate.

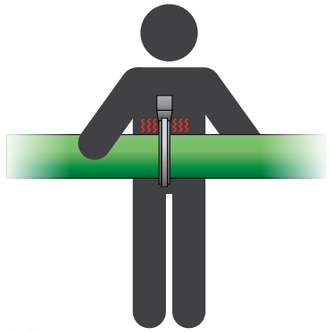
As you continue installing Aquatherm pipe, you will find a balance of prefab and in-place installation that works for you.

Looking for ways to help streamline the installation process can lead to significant savings in the overall installation time.

An installer can become proficient at heat fusion in a very short period of time, which can help make your less experienced installers more productive.

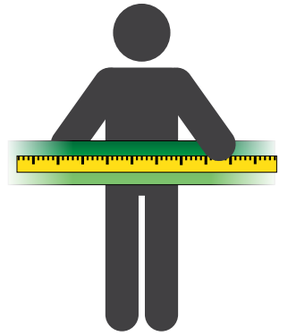
However, more advanced concepts like build strategy and layout are best managed by more experienced installers. Therefore, a typical crew installing Aquatherm will have a few masters or journeymen (primary) assisted by multiple apprentices and laborers (support).

Crew mix



Primary:
Focuses on the order of assembly, complicated fusion work, connection alignment, and directing the support crew.

The primary uses experience and planning to make the installation fast and efficient.



Support:
Focuses on handling, measurement and cutting, tool movement and set-up, and simple fusion work.

The support focuses on maximizing the productivity of the primary installer(s).

Tooling

Fusing Aquatherm pipe requires tools that meet certain criteria. The tools must comply with dimensional, temperature, and pressure requirements that are suitable for Aquatherm's PP-R pipe. Aquatherm's core focus is on pipe and fittings, not tools, so Aquatherm works with several tool manufacturers to promote the development and availability of these tools.

For better selection, pricing, and support, installers are encouraged to use tools from an approved tool manufacturer.

As of the printing of this edition, Aquatherm has approved tool lines from McElroy, Ritmo, Rothenberger, and Widos.

Contact information for these manufacturers can be found starting on page 2.36.

Each manufacturer has its own approach when it comes to tool function and design. We recommend exploring your options and finding the tools that are the best fit for you, your company, and the job you are working on.

Hand irons

½"-2" socket fusion:
You will need ½"-2" iron to do socket fusion work on 2" pipe and smaller. When working in the air, it's easiest to use the smallest suitable welding iron. 1" irons are also available for fusing small pipes in confined spaces.

½"-4" socket fusion:
A ½"- 4" iron can do all socket connections 4" and smaller. Its weight and power usage make it better suited to prefab and connections that can't be done with a smaller iron.

1" iron

2" iron

4" iron

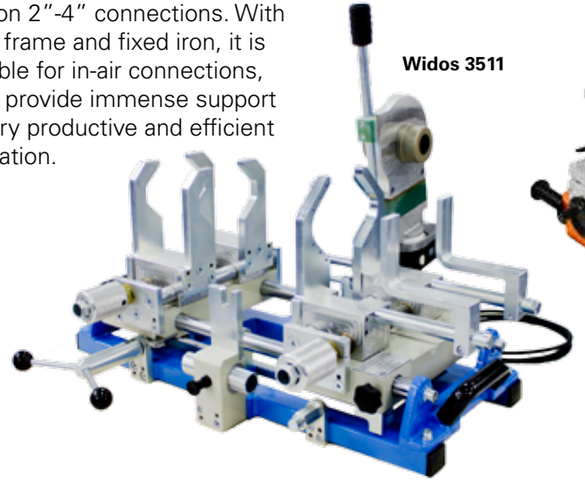
Socket fusion machines

A jig-style fusion machine eliminates the need for a second installer on 2”-4” connections. Designed for in-air fusion, it is minimalistic and nimble, and requires a hand iron for use.

Prisma Jig

Spider

A bench-style fusion machine eliminates the need for a second installer on 2”-4” connections. With its larger frame and fixed iron, it is not suitable for in-air connections, but does provide immense support and is very productive and efficient for fabrication.



Widos 3511

Prisma 125

Four-jaw butt fusion machines

Full-size butt fusion machines have two jaws on each side of the fusion (2x2), reducing the time spent loading and aligning the pipe.

Delta Dragon 315B

W 4400

Acrobat 160

Modified machine configurations

Most four-jaw machines can be modified to accommodate different fusion situations. Some machines allow a clamp to be removed (2x1), reducing weight and size. Others allow for a 3x1 set-up to accommodate shorter sections. Clamping with a single jaw generally requires additional alignment time.

W 4400

Acrobat 160

Manual butt fusion machines

Manual machines lack a hydraulic system, and instead use a mechanical device to generate the force required for fusion. They can be advantageous in tight spaces and on smaller jobs.

Pit Bull® 26

Ritmo Gamma 160

Widos Maxiplast

Larger crew vs. more tools

Tools should be viewed as a means to increase productivity, rather than as an additional cost. For example, socket fusions from 2”-4” are difficult to do with one installer and may require a second installer. However, a socket fusion machine makes larger socket fusions a one-person job, doubling productivity.

For larger sizes of pipe (6” and up), cooling times occupy the time of the machine, but not necessarily the installer. With proper set-up and planning, a single installer can perform several fusions at once, using multiple machines. This can double or triple the output of an installer, or team of installers.

The ratio of machines to installers will depend on the skill of the crew, the worksite conditions, and the nature of the installation. Having too few tools will slow down the job, and leave installers standing around with nothing to do. A good balance lets the crew stay engaged on productive work (no waiting around) while the fusion equipment is always being used on connections (no idle machines).

Having the right number of tools will greatly impact your installation time.

To find the correct number of tools for the job, evaluate the size and mix of the crew being used. Each person fusing pipe will need at least one tool suitable for fusing the size of pipe being installed. Some installers may be able to operate multiple tools, while installers in supporting roles may not need tools at all. This next section will give you examples of tool selection and crew mix, based on the type of work being done.

Work example #1: *Socket prefabrication (shop)*

Crew: 1 primary, 1 support

Tools: 1 benchtop, 1 iron, 1 jig, saw

Goal: Maximize connections per hour and eliminate unproductive time through specialization.

Process: Support measures and cuts pipe to length, cleans and preps edges for fusion. Primary uses benchtop machine to perform fusions on the main spool, uses iron and jig to fuse on additional pipe, fittings, and outlets while the benchtop connection cools.

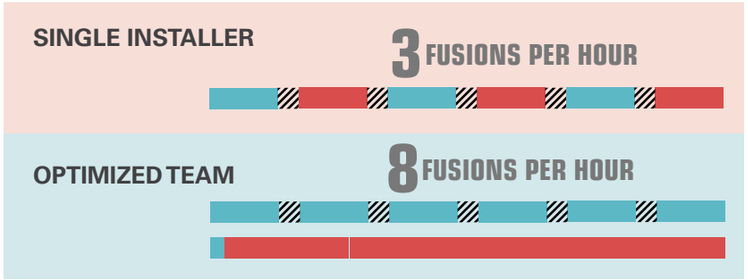
Fusion

Preparation

Unproductive time

(Time spent moving around the jobsite, setting up equipment, waiting for cooling, etc.)

Note: The "Fusions per hour" in the examples are just for comparison. Your actual productivity rates will vary with pipe size and installer experience.



Work example #2: *Butt fusion prefabrication (shop)*

Crew: 1 primary, 1 support

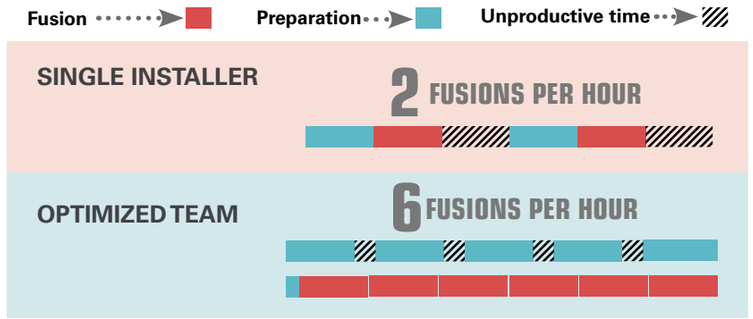
Tools: 2-3 butt fusion machines

Goal: Maximize connection per hour by eliminating downtime for the cooling phases.

Process: Primary performs the hot work (alignment, facing, bead-up, heating, and welding) on first machine while Support preps the second machine for fusion.

Primary then performs the hot work on the second machine while the first connection cools. If two machines are being used, Support preps a second connection for the first machine. If three machines are being used, Support sets up the third machine during this time. The cycle continues so that the Primary is always performing hot work on a fusion machine.

The decision to use 2 or 3 machines depends on the skill of the Primary and the duration of the cool-down time. A longer cool down allows for more simultaneous fusions.



Work example #3: *Socket fusion prefabrication (onsite)*

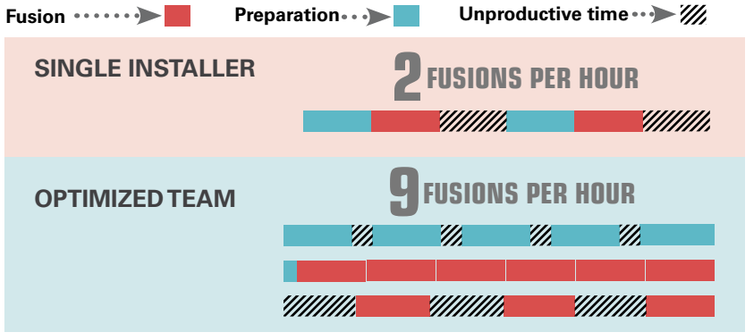
Crew: 1 primary, 2-3 support

Tools: 1 benchtop, 2-3 irons, 2-3 jigs, saw

Goal: Minimize in-air connections by building on the ground as much as possible.

Process: One Support measures and cuts pipe to length, cleans and preps edges for fusion. Primary uses benchtop machine to perform fusions on the main spool, uses iron and jig to fuse on additional pipe, fittings, and outlets while the benchtop connection cools. Simple straight lengths of pipe can have a socket coupling added to them to reduce the number of in-air connections. The remaining Supports take the fabricated sections to their intended locations and install them as directed. Fabbed sections could also be installed by a second Primary.

The exact mix and tasks of this crew depend on the skill of the Primary(ies) and Support(s) and the layout of the jobsite.



Work example #4: *Butt fusion prefabrication (onsite)*

Crew: 1 primary, 1-3 support

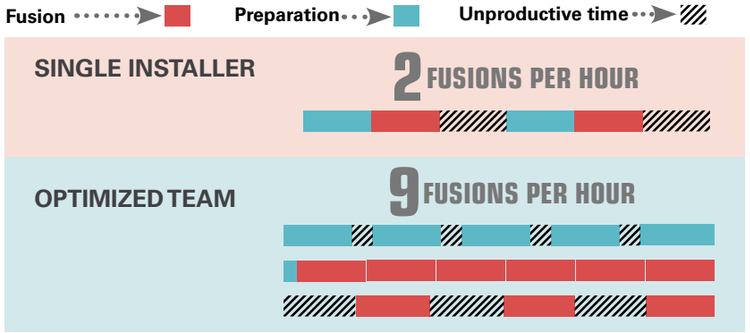
Tools: 2-3 butt fusion machines, welding irons and jigs if needed

Goal: Maximize connections per hour by eliminating downtime for the cooling phases and minimize in-air connections.

Process: Primary performs the hot work (alignment, facing, bead-up, heating, and welding) on first machine while one Support preps the second machine for fusion. Primary then performs the hot work on the second machine while the first connection cools.

If two machines are being used, Support preps a second connection for the first machine. If three machines are being used, Support sets up the third machine during this time. The cycle continues so that the Primary is always performing hot work on a fusion machine.

Support can also work on adding outlets and other connections as needed or take finished sections and install them as directed.



Work example #5: *Socket fusion (Linear)*

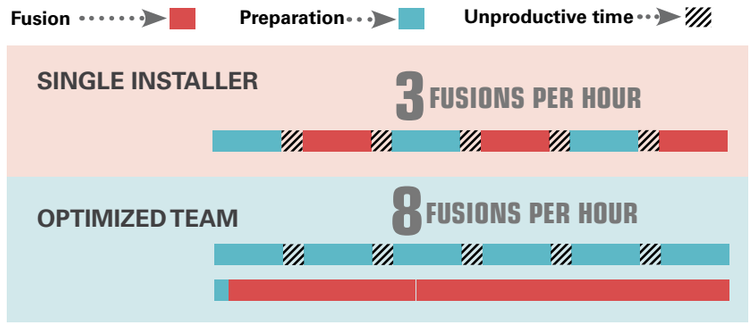
Crew: 1 primary, 1-2 support

Tools: 1 iron, 2 jigs, ladders or lift

Goal: Keep the single iron fusing pipe as much as possible by removing downtime.

Process: Support sets up first jig and then Primary performs the actual fusion. While Primary is performing the fusion, Support sets up the second jig. Primary then performs the second connection while Support detaches the first jig and sets it up on another connection. A second Support may be needed to carry and hang pipe.

This process can also be done on the ground, at which point the crew can lift the entire length into the air. Branch outlets can be added later.



Work example #6: *Butt fusion (linear)*

Crew: 1 primary, 1-2 support

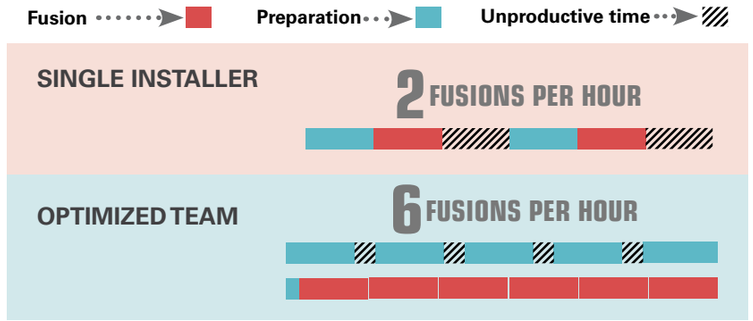
Tools: 2-3 butt fusion machines

Goal: Maximize connections per hour by eliminating downtime for the cooling phases.

Process: Primary performs the hot work (alignment, facing, bead-up, heating, and welding) on first machine while 1-2 Support prep the second machine for fusion. Primary then performs the hot work on the second machine while 1-2 Support set up the third machine. Pipe in the air may require the full cooldown time, so three machines will be needed to minimize downtime.

If the pipe is fused on the ground and hoisted into place, two machines and one Support may be sufficient. Branch outlets can be added later.

This process can also be done on the ground, at which point the crew can lift the entire length into the air. Branch outlets can be added later.



Joining spools: Socket and butt fusion

As part of using prefabrication, you will need to have a plan for installing the spools once they are built. Time saved by using prefabrication can be lost trying to rework sections that aren't easy to join together.

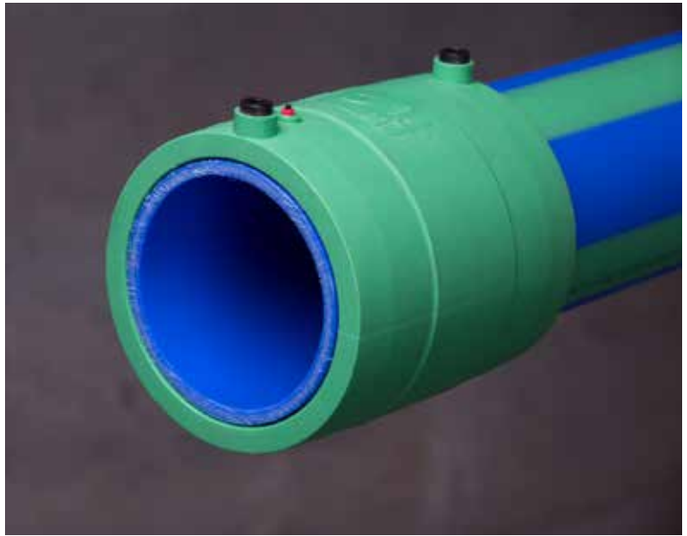
Traditional fusion methods (socket and butt welding) require a few inches of lateral movement. If that movement is available, then socket and butt fusion will be the most cost-effective and secure means of joining the spools. For straight lengths, leave the moving spool unclamped until the fusion is complete.

Places where the pipe changes direction (such as elbows) allow the installer to take advantage of the pipe's flexibility. (See pages 4.16 and 4.17 for safe bending lengths). Using a fusion machine, the installer can force the pipe to bend, perform the fusion, and bring the pipe and fitting together for a square connection (See series above).

Joining spools: Electrofusion

In areas where lateral movement is not possible, but fusion welding is still the preferred method, electrofusion couplings can join sections up to 10" without lateral movement.

One side of the pipe is peeled back far enough for the electrofusion socket to be used as a slip coupling (right). Once the spool is in place, the coupling is slid back to center (below).



Joining spools: Flanges

Flange adaptors can join the pipe to itself or another material. Aquatherm flange connections consist of two parts: the adaptor and the ring (see page 4.26). Flange adaptors are a common connection method in areas where traditional fusion is difficult or impossible. Flange transitions are available up to 24".

Planning for flanged spools will include considerations for the thickness of the gasket and for any equipment (such as valves) being installed between the spools. This affects both build-length of the spool and the length of the bolts.

Chapter 4: Planning

Beyond heat fusion, there are a number of differences between installing Aquatherm pipe and installing other systems. Your skill in planning and layout can help you take advantage of these differences, and avoid common pitfalls. This chapter will discuss important installation details, such as pipe sizing, hanger spacing, expansion controls, insulation, and pressure testing.

Remember that, when using an engineered system like PP-R, planning and finesse will yield better results than brute force.

Technical bulletins

Aquatherm works hard to deliver the best training and most accurate product information available to you, the installer.

However, due to the wide variety of applications that Aquatherm pipe is used in, and the ongoing development of third-party tools, clamps, insulations, and other solutions, staying up on the best practices requires a small bit of effort.

In order to keep you informed of new techniques and requirements, Aquatherm frequently releases technical bulletins to fill in the gaps between editions of the installer manual. Technical bulletins also give more detailed explanations of installation techiques than will fit in the installer manual.

As a result, in the event of a discrepancy between this installer manual and the current technical bulletins on the Aquatherm website, the bulletins should be considered correct.

Aquatherm recommends reading the technical bulletins in addition to this manual.

Notifications regarding new technical bulletins can be found at: http://aquatherm.com/technical-bulletins

If you are installing metal clamps, use only rubber- or felt-lined clamps, like the one shown here. You may use tape to pad the space between the PP-R and the metal on non-clamping hangers, such as clevis hangers. Plastic clamps are safe without additional padding.

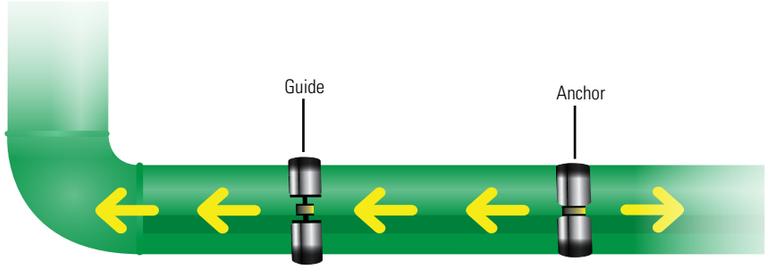
Metal clamps (even plastic-safe clamps) can damage hot water pipes, and can condense when used on cold water pipe. When installing chilled water lines in high-humidity areas, use a non-crushable pipe shield (pictured above).

Metal that is in direct contact with Aquatherm pipe may sweat in certain chilled applications, even if the pipe itself shows no signs of condensation.

Anchors and guides

For the purposes of dealing with linear expansion, there are two types of supports: anchors and guides. Anchors are tight against the pipe and prevent movement through that point. Guides support the pipe, but are loose and allow movement through the joint.

The table on page 4.35 provides the best match of CTS and IPS sizes.



Support intervals and hanger spacing (SDR 11 non-MF)

With PP-R, the hanger spacing varies with the expansion in the pipe. For cold water pipes, there is a negligible amount of expansion, or even some contraction, so only one spacing is given for non-MF installations. For heated or chilled applications, use MF pipe. The limited expansion helps increase hanger spacing.

The temperature difference is based on an ambient temperature of 68 °F. For example, a 100 °F system in a 100 °F room should have support spacing based on **(100 °F - 68° F= 32°F)** temperature differential, not zero differential. In systems with a 0 or negative ΔT, use the maximum spacing.

Note: These support intervals are based on the pipes carrying water. If the pipes are carrying a material that is denser than water, additional support may be required. Alternative spacing should be confirmed in the chemical compatibility report. The instructions for submitting a chemical inquiry can be found on page 4.20.

Pipe diameter																
½″ 20 mm	¾″ 25 mm	1″ 32 mm	1 ¼″ 40 mm	1 ½″ 50 mm	2″ 63 mm	2 ½″ 75 mm	3″ 90 mm	3 ½″ 110 mm	4″ 125 mm	6″ 160 mm	8″ 200 mm	10″ 250 mm	12″ 315 mm	14″ 355 mm	16″ 400 mm	18″ 450 mm
Support intervals (ft)																
4	4	4	4	4	4.6	4.9	5.2	5.9	6.6	7.2	7.5	7.9	8.4	9.5	10.5	11.2

Support intervals (SDR 7.4 and 11 MF)

ΔT Difference in temp.	Pipe diameter																
	½″ 20 mm	¾″ 25 mm	1″ 32 mm	1 ¼″ 40 mm	1 ½″ 50 mm	2″ 63 mm	2 ½″ 75 mm	3″ 90 mm	3 ½″ 110 mm	4″ 125 mm	6″ 160 mm	8″ 200 mm	10″ 250 mm	12″ 315 mm	14″ 355 mm	16″ 400 mm	18″ 450 mm
	Support intervals (ft)																
0 °F (0 °C)	4	4.6	5.2	5.9	6.7	7.5	8	8.5	9.5	10.5	11.2	11.3	11.5	12.5	13.5	15	16
36 °F (20 °C)	4	4	4	4.4	5.1	5.7	6.1	6.4	7.1	7.9	8.9	9	9.2	10.1	11	14	15
54 °F (30 °C)	4	4	4	4.4	5.1	5.7	6.1	6.4	6.9	7.4	8	8.2	8.4	9.2	10	12	13
72 °F (40 °C)	4	4	4	4.1	4.8	5.4	5.7	6.1	6.6	7.1	7.7	7.9	8	8.7	9.5	11	12
90 °F (50 °C)	4	4	4	4.1	4.8	5.4	5.7	6.1	6.2	6.4	6.7	6.9	7.1	7.8	8.5	10	11
108 °F (60 °C)	4	4	4	4	4.4	5.1	5.4	5.7	5.9	6.1	6.4	6.6	6.7	7.1	7.5	9	10
126 °F (70 °C)	4	4	4	4	4.3	4.8	5.1	5.4	5.6	5.7	6.1	6.2	6.4	6.7	7	8	8

Support intervals (SDR 17.6 MF)

ΔT Difference in temp.	Pipe diameter										
	4″ 125 mm	6″ 160 mm	8″ 200 mm	10″ 250 mm	12″ 315 mm	14″ 355 mm	16″ 400 mm	18″ 450 mm	20″ 500 mm	22″ 560 mm	24″ 630 mm
	Support intervals (ft)										
0 °F (0 °C)	8.4	8.5	8.7	9.0	9.2	9.4	9.7	10.0	10.3	10.7	10.8
36 °F (20 °C)	6.1	6.2	6.6	6.7	6.9	7.1	7.5	7.9	8.4	8.9	9.2
54 °F (30 °C)	5.7	5.9	6.2	6.4	6.6	6.7	7.2	7.5	8.0	8.5	9.0
72 °F (40 °C)	5.6	5.7	5.9	6.2	6.2	6.4	6.9	7.4	7.7	8.2	8.7
90 °F (50 °C)	5.2	5.4	5.7	5.9	6.1	6.1	6.6	7.1	7.5	7.9	8.4
108 °F (60 °C)	4.9	5.1	5.4	5.6	5.7	5.7	6.1	6.6	7.1	7.5	7.9
126 °F (70 °C)	4.6	4.8	5.1	5.2	5.6	5.7	5.7	6.2	6.7	7.2	7.5

Increased hanger spacing

In some applications, the positioning of hangers is determined by outside factors, such as a retrofit with hangers from previous metal pipes. In order to accommodate for these variations, installers may use an in-line support, like the one shown here.

The supported distance can be added to the hanger spacing. For example, a pipe with a 6 ft spacing requirement can be hung on 8 ft spacers if 2 ft of the pipe is supported in-line.

The supports must clip securely to the pipe without damaging the outer wall. In-line supports will need to be installed under the insulation, but still need a non-metallic barrier layer (such as tape) between the metal surface of the in-line support and the pipe. Approved in-line supports* are available through Walraven.

*Other manufacturers may provide a similar product that was not approved by Aquatherm at the time of printing. These supports, if acceptable, can be approved by Aquatherm upon request.

Fire rating

For fire-rated assemblies, such as return-air plenums, Aquatherm pipe will need to be protected by a fire-rated insulation or wrap. If the pipe needs to be insulated (HW, HWR, CHW), any material that meets the fire/smoke requirements of ASTM E84 or CAN/UL S102.2 can be used. If insulation is not required (DCW), a simple wrap meeting the fire/smoke requirements may be installed over the pipe.

In areas requiring a listed system, recent changes to the model mechanical codes (2012 IMC and UMC) have made it clear that any product which is listed and labeled as meeting the flame and smoke requirements of ASTM E84 and CAN/UL S102.2 may be used to protect the pipe. Always obtain approval of your local authority having jurisdiction before installing any pipe insulation/wrap. Although the updated building codes allow for the use of any plenum-rated insulation to protect the pipe, it should be noted that the fittings will be required to be wrapped as well as the pipe in order to meet the fire/smoke standards. Again, confirm local authority approval before beginning.

For fire-rated partition/assembly penetrations, Aquatherm recommends that installers work with the fire stopping manufacturer. The current list can be found at Aquatherm.com/firestopping.

By allowing the use of multiple materials to be installed with our product, the decision for insulation, flame/smoke wraps, and fire stopping can be made by the installer, engineer, and owner based on their preferences and the most cost-effective solutions for the project.

Linear expansion

Linear expansion occurs when the pipe is heated. The amount of expansion is determined by the difference in temperature. It is important to know how much expansion will occur during system operation and plan for it. Aquatherm's MF pipes use a combination of glass fibers and PP-R to reduce linear expansion and contraction by 75%.

MF pipes can be fused without any special tools, treatment, or prep work. Fuse MF pipes using the same techniques as non-MF pipe.

For hot water, heating, and chilled applications, use a MF pipe, such as **aquatherm green pipe**® SDR 7.4 or **aquatherm blue pipe**® SDR 17.6 or 11.

For ambient-temperature applications, such as gray water or DCW, use a non-MF pipe, such as **aquatherm green pipe** SDR 11 or **aquatherm lilac pipe**®.

The MF extrusion process produces a middle layer with expansion-inhibiting properties. The percentage of PP-R is high enough to ensure a proper bonding between the layers, so the middle layer cannot be separated from the inner and outer layers.

Calculating expansion

In order to deal with expansion properly, you will need to know how much expansion to expect. Expansion is based on the following factors:

L = the length of pipe
Ti = the temperature of the pipe at the time the pipe is clamped down
Tw = the temperature of the water inside the pipes during operation
ΔT = the difference between the working temperature (Tw) and the installation temperature (Ti):
α = the coefficient of expansion = 0.0002367 in/ft °F for MF pipe
= 0.001008 in/ft °F for non-MF pipe

Multiply the length of the pipe (L) by the temperature difference (ΔT), and again by the expansion coefficient (α), as shown here:

$L \times \Delta T \times \alpha = \Delta L$ (Linear Expansion or change in length)

This will give you the expected expansion in inches. The tables on the next two pages provide some of these calculations. Note that the length of expansion is the same for all diameters of pipe.

Linear expansion for non-MF pipe

Pipe length	Difference in temperature $\Delta T = T_{operating\ temperature} - T_{installation\ temperature}$							
	10 °F	20 °F	30 °F	40 °F	50 °F	60 °F	80 °F	100 °F
	Linear expansion ΔL (in)							
10 ft	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0
20 ft	0.2	0.4	0.6	0.8	1.0	1.2	1.6	2.0
30 ft	0.3	0.6	0.9	1.2	1.5	1.8	2.4	3.0
40 ft	0.4	0.8	1.2	1.6	2.0	2.4	3.2	4.0
50 ft	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0
60 ft	0.6	1.2	1.8	2.4	3.0	3.6	4.8	6.0
70 ft	0.7	1.4	2.1	2.8	3.5	4.2	5.6	7.0
80 ft	0.8	1.6	2.4	3.2	4.0	4.8	6.4	8.0
90 ft	0.9	1.8	2.7	3.6	4.5	5.4	7.2	9.0
100 ft	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0
150 ft	1.5	3.0	4.5	6.0	7.5	9.0	12.0	14.9
200 ft	2.0	4.0	6.0	8.0	10.0	12.0	15.9	19.9

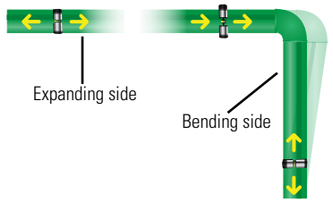
Linear expansion for MF pipe

Pipe length	Difference in temperature $\Delta T = T_{operating\ temperature} - T_{installation\ temperature}$							
	10 °F	20 °F	30 °F	40 °F	50 °F	60 °F	80 °F	100 °F
	Linear expansion ΔL (in)							
10 ft	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2
20 ft	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5
30 ft	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.7
40 ft	0.1	0.2	0.3	0.4	0.5	0.5	0.7	0.9
50 ft	0.1	0.2	0.3	0.5	0.6	0.7	0.9	1.1
60 ft	0.1	0.3	0.4	0.5	0.7	0.8	1.1	1.4
70 ft	0.2	0.3	0.5	0.6	0.8	1.0	1.3	1.6
80 ft	0.2	0.4	0.5	0.7	0.9	1.1	1.5	1.8
90 ft	0.2	0.4	0.6	0.8	1.0	1.2	1.6	2.1
100 ft	0.2	0.5	0.7	0.9	1.1	1.4	1.8	2.3
150 ft	0.3	0.7	1.0	1.4	1.7	2.1	2.7	3.4
200 ft	0.5	0.9	1.4	1.8	2.3	2.7	3.6	4.6

Expansion controls

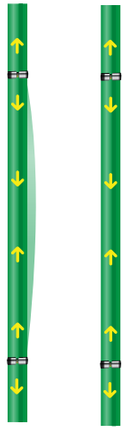
To control linear expansion, you will need to isolate and direct the expansion in a safe way. Expansion will move away from anchors and through guides until it reaches your expansion control or another anchor. On long runs, you should use an expansion control every 120 ft. Remember that branches and other fittings cannot expand through an anchor or guide. Common expansion controls include:

Sliding elbow: Expansion is directed to where the pipe changes direction. The force of the expansion is absorbed by the flexibility of the bending side.

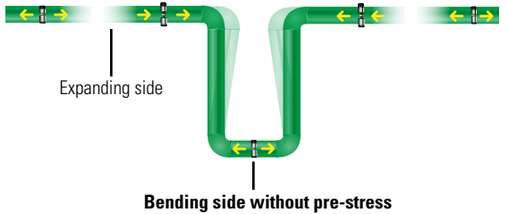


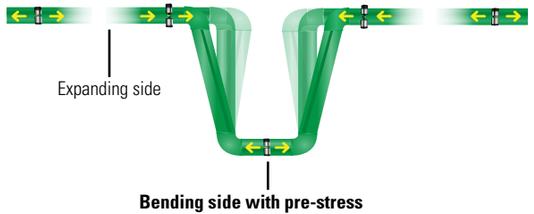
Linear isolation: For vertical installations, expansion can be contained to each floor, leaving each 10 ft space with a fraction of an inch of expansion. This will cause a slight bowing of the pipe, which can be minimized using a midfloor guide.

Note: Only MF pipes can absorb their expansion. Non-MF pipes in heated applications must have other expansion controls installed every 30 ft. Expansion should be handled by the engineer in the design documents and those documents must be followed. The information here is for reference and verification only.



Expansion loop: Used on long, straight runs. Two distant anchors direct expansion to a central loop. The loop can even be pre-stressed to accommodate additional expansion, or to give a square appearance during operation.





Sliding end: Used for short distances where the pipe ends with a cap. The distance between the end of the pipe and the wall (or other obstruction) must be less than the expansion. The pipe should be supported as closely to the end as possible.

Length of bending side

The following table gives the minimum distance between the elbow of the bending side and the first support on that pipe. The force of expansion can safely bend the pipe over this distance.

Pipe dimension in inches (mm)	Linear expansion in inches (")											
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"
	Length of bending side (in)											
½" (20)	13	19	23	27	30	33	35	38	40	42	44	46
¾" (25)	15	21	26	30	34	37	40	42	45	47	50	52
1" (32)	17	24	29	34	38	42	45	48	51	54	56	59
1¼" (40)	19	27	33	38	42	46	50	54	57	60	63	66
1 ½" (50)	21	30	37	42	47	52	56	60	64	67	70	73
2" (63)	24	34	41	48	53	58	63	67	71	75	79	82
2 ½" (75)	26	37	45	52	58	64	69	73	78	82	86	90
3" (90)	28	40	49	57	64	70	75	80	85	90	94	99
3 ½" (110)	31	44	54	63	70	77	83	89	94	99	104	109
4" (125)	34	47	58	67	70	82	89	95	101	106	111	116

Pipe dimension in inches (mm)	Linear expansion in inches (")											
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"
	Length of bending side (in)											
6" (160)	38	54	66	76	85	93	100	107	114	120	126	131
8" (200)	42	60	73	85	95	104	112	120	127	134	141	147
10" (250)	47	67	82	95	106	116	125	134	142	150	157	164
12" (315)	53	75	92	106	119	130	141	151	160	168	177	184
14" (355)	56	79	97	112	126	138	149	159	168	178	186	194
16" (400)	60	84	103	119	133	146	158	169	179	188	198	206
18" (450)	63	89	109	126	141	155	167	178	190	200	210	219
20" (500)	67	94	115	133	149	163	176	188	200	211	221	231
22" (560)	71	100	122	141	158	173	187	199	212	223	234	244
24" (630)	75	106	130	150	167	183	198	212	224	237	248	259

Length of bending side with pre-stress

The following table gives the minimum distance between the elbow of the pre-stressed bending side and the first support on that pipe, splitting the expansion. Use the first table if you are pre-stressing for a square finish.

Pipe dimension in inches (mm)	Linear expansion in inches (")											
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"
	Length of bending side (in)											
½" (20)	9	13	16	19	21	23	25	27	28	30	31	33
¾" (25)	11	15	18	21	24	26	28	30	32	34	35	37
1" (32)	12	17	21	24	27	29	32	34	36	38	40	42
1¼" (40)	13	19	23	27	30	33	35	38	40	42	44	46
1 ½" (50)	15	21	26	30	34	37	40	42	45	47	50	52
2" (63)	17	24	29	34	38	41	45	48	51	53	56	58
2 ½" (75)	18	26	32	37	41	45	49	52	55	58	61	64
3" (90)	20	28	35	40	45	49	53	57	60	64	67	70
3 ½" (110)	22	31	39	44	50	54	59	63	67	70	74	77
4" (125)	24	34	41	47	53	58	63	67	71	75	79	82

Length of bending side with pre-stress

Pipe dimension in inches (mm)	Linear expansion in inches (")											
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"
	Length of bending side (in)											
6" (160)	27	38	46	54	60	66	71	76	80	85	89	93
8" (200)	30	42	52	60	67	73	79	85	90	95	99	104
10" (250)	34	47	58	67	75	82	89	95	101	106	111	116
12" (315)	38	53	65	75	84	92	100	106	113	119	125	130
14" (355)	40	56	69	79	89	97	105	112	119	126	132	138
16" (400)	42	60	73	84	94	103	112	119	126	133	140	146
18" (450)	45	63	77	89	100	109	118	126	134	141	148	155
20" (500)	47	67	82	94	105	115	125	133	141	149	156	163
22" (560)	50	71	86	100	112	122	132	141	150	158	165	173
24" (630)	53	75	92	106	118	130	140	150	159	167	175	183

Chemical compatibility

PP-R is safe with most chemicals, in most environments, and with nearly any quality of water.

However, there are a few applications, such as high chlorine concentrations, that have adverse effects on the pipe and fittings. If you are installing the pipe in a chemically corrosive application, the engineer on the job should have already submitted a chemical compatibility report. If no report was submitted, go to Aquatherm.com/compatibility and follow the directions provided there.

Inquiries are submitted to Aquatherm's testing laboratories in Germany for verification normally within 24-48 hours.

Many common applications are pre-approved, and may be answered on the same day. Aquatherm pipes are safe to use with propylene and ethylene glycols at any concentration.

Be aware that even if the Aquatherm pipe is compatible with the chemical being transported, other materials in the system may not be. Make sure that all parts of the system are compatible with the medium being carried before installing them. And, while Aquatherm pipe does not require treatment to protect it from corrosion, ferrous metals in the system will. Do not mix Aquatherm pipe with other piping systems in conditions that will cause the other system to fail.

Integration with copper tubing

When integrating Aquatherm piping systems with other systems, make sure that the operating parameters for PP-R won't damage the other materials. When there is extensive use of copper piping in conjunction with PP-R, care should be taken to ensure the operating conditions will not cause dissolution or corrosion of the copper.

Aquatherm recommends following the Copper Development Agency's guidelines for sizing, temperature and flow speed in copper pipe. This will also help ensure that the copper levels in the water do not approach the regulatory action levels.

Sustained high levels of copper ions in a water system can damage wetted surfaces within the system, even PP-R. Damage caused by unregulated copper ions may void the warranty.

Alternatively, you can avoid using large amounts of new copper upstream of the PP-R in hot water recirculation lines. If the copper fails, it may degrade the PP-R as well, shortening its service life. Small amounts of copper from valves and other equipment will generally not cause an issue. For maximum longevity, recirculation lines for domestic hot water should not exceed a flowspeed of 4 ft/s unless the piping is all PP-R.

If you are adding PP-R to an existing copper system, the level of free copper in the water should be tested. These levels should not exceed 0.5 P.P.M., and are considered actionable by the EPA at 1.3 P.P.M. High levels of free copper indicate that the copper pipe is eroding due to system and/or water conditions.

PP-R to copper transition fittings

To facilitate transitions to fixture units or copper components, Aquatherm offers a PP-R to copper stub out, intended for use with angle stops, flush valves, and other terminations. It is compatible with both compression and solder-type connections.

These fittings are combination of a custom Aquatherm PP-R socket with a gasket and copper stub added by Sioux Chief Manufacturing. The fused PP-R portion is covered under Aquatherm's warranty. The copper portion and gasket are covered under a warranty from Sioux Chief.

Instructions are included with the fitting. Always follow those directions to avoid damaging the fitting. PP-R to copper transitions are available in ½", ¾", and 1" sizes.

Connecting to a boiler

Aquatherm piping is required to pass a system malfunction test of 8,760 hours (~1 year) at 230°F. This does not mean the piping is intended to be operated at this condition, but rather that it can withstand temperatures above 180°F were this to occur due to a boiler malfunction. This allows Aquatherm pipe to be connected directly to a boiler in many cases.

Some codes may require a minimum of 18" of copper tubing from the boiler to the Aquatherm PP-R. (Note: this is not enough copper tubing to create an issue with copper ions as long as the copper is properly sized).

It is safest to complete all heat-producing connections, such as soldering, before making the Aquatherm piping connections to the copper piping. When this is not a possibility, one solution is to install a copper union that can be uncoupled until the soldering is complete. In any case, do not expose any PP-R piping and transition fittings to temperatures in excess of 170 °F during the copper soldering process. Excessive heat may distort and deform any O-ring seals and fitting connections, resulting in a leak during testing or after system start-up.

Perform all solder joints on copper piping at the following minimum distances from the PP-R piping along the copper tube:

10" from a ½" or ¾" PP-R fitting or pipe;
18" from a 1" or 1¼" PP-R fitting or pipe;
20" from a 1½" PP-R Pipe fitting or pipe;
22" from a 2" (or larger) PP-R fitting or pipe.

For additional safety, use a water soaked cloth or commercial heat blocking agent between the solder joint and the PP-R piping and immediately cool the copper tube and the transition fitting after the soldering is completed.

Bushings, reducers, and reducing couplings

To help limit the number of reducing fittings that a wholesaler must stock, Aquatherm uses bushings which are designed to be inserted into another fitting, such as a socket, tee, or elbow. When reducing, the side being reduced from is male and acts like a piece of pipe in that size. The side being reduced to is female and acts like a socket in the smaller size.

The female side (smaller pipe size) is labeled with the fitting dimension and has a stop on the inside, just like a regular socket fitting. The male side (larger pipe size) has a bevel on the face and a thicker wall than a normal socket connection. Bushings run from 4" down to 1/2".

Reducers are used with larger pipes and are butt welded on both sides. They may go directly to a pipe or to a fitting.

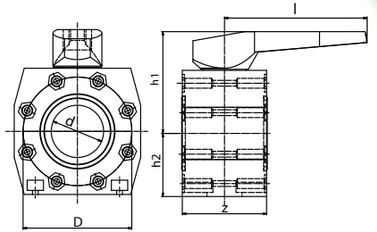
Aquatherm also provides reducing couplings to reduce the pipe during a straight run. Sizes under 4" are socket fused on both ends. Sizes that reduce from above 4" to 4" or smaller will butt fuse on the larger size and socket fuse on the smaller size.

Bushing

Large PP-R ball valve *(3"-6")*

The benefits of an all polypropylene system can be realized up through 6" with the large diameter PP-R ball valves available from Aquatherm. The valves flange in-line, and can be installed quickly and easily as long as the following items are addressed:

- Be aware that the bolt hole pattern is built to the ISO (European) standard. Therefore, flange rings and full face gaskets will need to match the pattern. Aquatherm rings do match, and the dimensions are available on the website.
- The nuts inset in the valve are a coarse metric thread, and do require metric bolting. For bolt dimensions, see page 5.49.
- At the time of print, Aquatherm does not source gaskets or bolts. We intend to add them to our product line in the near future.



Threaded connections

Aquatherm offers a wide range of threaded transitions to connect with non-fusible system components. These transitions have a machined brass or stainless steel thread mold-injected into a PP-R base for maximum strength.

Use stainless steel fittings in chemically aggressive applications. Lead-free brass is available for potable applications. Industrial brass fittings are available for all other non-potable applications. Do not use the industrial transition fittings in applications that call for lead-free brass.

When installing these threaded connections, there are a few important things to remember:

- 1-2 turns past hand-tight, do not bottom out. Tape only, not pipe dope unless absolutely necesary. Do NOT bottom out in threaded fitting.
- Your sealant needs to be compatible with brass or stainless steel, as you are not threading to the PP-R.
- Always apply counter pressure on the fitting when tightening the connection. If the fitting has a hex head, place your wrench there (a crescent wrench may give you a more secure fit). For fittings without a hex head, use a pipe wrench on the PP-R body of the fitting. This will scratch up the fitting, but will not cause structural damage.

Female Hex Brass

Male Round SS

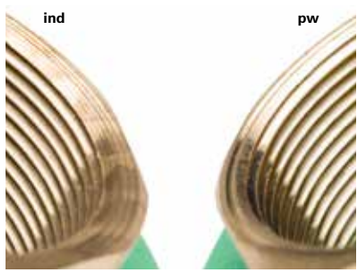
Male Hex Brass

Brass identification

To comply with the new Reduction of Lead in Drinking Water Act, Aquatherm offers two lines of brass fittings: lead-free (potable) and industrial (non-potable). The two lines are identified by separate part numbers and the following distinctive visual cues:

Industrial

- A double groove (face of the female, interior of the male) etched in the metal.
- “cNSF us-ind” printed on the body.

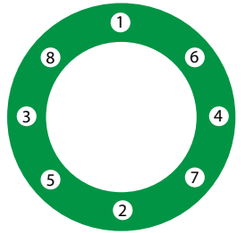


Lead-free

- A single groove (face of the female, interior of the male) etched in the metal.
- “cNSF us-pw-G” printed on the body.

Flanges

To transition to other piping systems and mechanical equipment, Aquatherm provides a full range of flange adapters. Aquatherm's flange rings are uniquely designed to have a metric center and an ANSI bolt pattern. For a flange transition, you will need both the adapter (fusible fitting) and the ring.



Aquatherm recommends using a full face rubber (black EPDM or red SBR) gasket with its flanges. Viton® gaskets may also be used if needed for chemical resistance. For lower pressure systems, and smaller diameters (4" and down), ring gaskets may be used but there may be blow-outs during pressure testing. Ring gaskets are also more susceptible to leaks if the flanges and connected piping are not aligned properly during installation. The gasket should have an inside diameter consistent with the ID of the flange adapter (see page 5.28).

Bolt tightening should follow the "star" pattern regardless of flange size and number of bolts (see example). Tighten all bolts to a third of the torque rating, and repeat until fully tightened. Do not overtighten the bolts. Bolt length will depend on the thickness of gasket and flange ring being used.

Aquatherm flange bolt torque and size

Nominal pipe size	Torque		Bolts		
	N-m	ft-lb	Number	Diameter	Washers
½" (20mm)	9	7	4	1/2	Yes
¾" (25mm)	14	10	4	1/2	Yes
1" (32mm)	20	15	4	1/2	Yes
1 ¼" (40mm)	20	15	4	1/2	Yes
1 ½" (50 mm)	34	25	4	1/2	Yes
2" (63mm)	41	30	4	5/8	Yes
2 ½" (75mm)	54	40	4	5/8	Yes
3" (90mm)	54	40	8	5/8	Yes
3 ½" (110mm)	54	40	8	5/8	Yes
4" (125mm)	54	40	8	5/8	Yes

Nominal pipe size	Torque		Bolts		
	N-m	ft-lb	Number	Diameter	Washers
6" (160mm)	75	55	8	3/4	Yes
8" (200mm)	102	75	8	3/4	Yes
10" (250mm)	122	90	12	7/8	Yes
12" (315 mm)	142	105	12	7/8	Yes
14" (355 mm)	203	150	12	1	Yes
16" (400 mm)	203	150	16	1	Yes
18" (450 mm)	237	175	16	1-1/8	Yes
20" (500 mm)	237	175	20	1-1/8	Yes
24" (630 mm)	305	225	20	1-1/8	Yes

Note: These are typical values for rubber gaskets with lubricated (lightly greased) or plated bolts. Values may be increased for harder gaskets or plain/un-plated bolts.

Butterfly valves

Aquatherm produces modified flange adapters for use with ANSI butterfly valves. The part numbers for these are distinguished by adding a "BV" to the end. Note that these are available only for sizes 6" and above, excluding 22", as the ANSI and DIN dimensions overlap in smaller sizes. The part numbers can be found on page 5.28.

Tolerances with some butterfly valves may be very tight. Opening the valve before bolting it in place can help center the valve and ensure proper actuation.

Modified flange adapter

Pipe size	Thread size		
	½"	¾"	1"
1 ¼"	M/F	M/F	
1 ½"	M/F	M/F	
2"	M/F	M/F	
2 ½"	M/F	M/F	F
3"	M/F	M/F	F
3 ½"	M/F	M/F	F
4"	M/F	M/F	F
6"	M/F	M/F	F
8"	F	F	F
10"	F	F	F

Branch lines

Pipe size	Outlets available
1 ¼"	½" — ¾"
1 ½"	½" — ¾"
2"	½" — 1"
2 ½"	½" — 1 ¼"
3"	½" — 1 ¼"
3 ½"	½" — 1 ½"
4"	½" — 2"
6"	½" — 3"
8"	½" — 4"
10"	½" — 4"
12"	2" — 6"
14"	2" — 8"
16"	2" — 10"
18" — 24"	2" — 12"

There are two ways to install branch lines on Aquatherm pipe: tees and outlets. Tees are full-sized fittings that either socket fuse or butt fuse in-line. These are usually used for branches that are within two sizes of the main line. Tees can be found on page 5.17 and reducing tees on page 5.19.

Outlets are smaller fittings that use outlet fusion to attach to the side of the pipe (see page 2.24). The table on the left gives the available branches for each pipe size. Fusion outlets are listed on page 5.26.

The table on the far left shows the available outlets with metal threads, listed on page 5.41.

Buried applications

Unlike many other piping materials, PP-R is able to absorb the stress caused by expansion within certain limits. The multi-layer faser (MF) construction helps keep the pipe within these limits for most applications.

In cases where the pipe needs to be buried in soil, sand, or concrete, PP-R is safe, non-leaching, and resistant to crushing or damage. Aquatherm pipe is also suitable for directional boring, if a properly sized pulling head is used.

Buried installations generally do not require additional consideration for the expansion of MF pipes. Resistance to movement from the concrete or backfill will restrict the natural expansion or contraction of the pipe. The expansive force of PP-R is much lower than metal pipes.

Aquatherm pipe is safe to use with insulating backfills. Due to the thermal resistance of PP-R, dry sand is often acceptable as a backfill for insulation purposes. Six inches of dry sand equates to roughly one inch of fiberglass insulation. When penetrating through concrete on an application where the pipe can expand and contract regularly, a shield or protective layer must be used and should be installed per local codes. It is best to anchor the pipe at that location.

Maximum pull force

The following table gives the maximum pull force for directional boring or similar applications. Make sure that the pull heads you are using are compatible with metric PP-R pipe. Pull forces include a 40% safety factor.

Pipe diameter	Max pull force (lb)		
	SDR 7.4	SDR 11	SDR 17.6
6″ — 160 mm	16055	11353	7362
8″ — 200 mm	25087	17739	11503
10″ — 250 mm	39198	27718	17973
12″ — 315 mm	62230	44005	28534
14″ — 355 mm	79038	55890	36241
16″ — 400 mm	-	70958	46012
18″ — 450 mm	-	89806	58233
20″ — 500 mm	-	-	71893
22″ — 560 mm	-	-	90183
24″ — 630 mm	-	-	114137

Bending Aquatherm pipe

In general Aquatherm does not recommend bending Aquatherm pipe as a means of making a change in direction or going around obstacles. However, there are instances when the pipe is required to bend, such as buried and trenchless applications.

The pipe may be bent or bowed a maximum of 5° off straight in a 20-foot section or to a bending radius of 100 x the pipe outside diameter. For an 8" SDR 11 pipe with an outside diameter of 200 mm (or 7.87 inches), the bending radius is 787 inches or 66 feet.

This applies for all SDR's and pipe diameters for the Green and the Blue pipe, with and without faser. The only exceptions to this are Aquatherm's coiled tubing products.

When using coiled Aquatherm products for radiant floor, snow melt, field/turf warming or similar applications, the bending radius should be no less than 8 times the outside diameter of the tubing being used. For example, ½" tubing (OD = 20 mm) 8 x 20 = 160 mm bending radius. 160 mm = 6.3 inches bending radius or 12 inches on center.

Always bend the tubing in the coil direction and use a bending guide to prevent the tube from kinking.

Please note that considerable force may be required to field bend the pipe, and the pipe may spring back forcibly if the restraints slip or are inadvertently released while bending or after installation. Observe appropriate safety precautions during field bending.

Insulation sizing, thrust blocking, noise generation, and vibration isolation

Insulation sizing: Aquatherm's pipes are made using a metric OD, so standard insulations do not always fit over the pipe. The table on the right gives the best (closest) fit between IPS and CTS sizes, and then the best fit using only the more common IPS size. These sizes also work for clamps and hangers. Insulations with metric IDs and imperial ODs will use Aquatherm's ND.

Thrust blocking: Due to the inherent strength and integrity of fused connections, thrust blocking is never required in buried applications.

Noise generation: Due to the natural noise attenuation and the ability to absorb forces of water hammer, the flow velocity of Aquatherm pipe can be higher (between 8 and 14 ft/s, based on size) because noise generation is not an issue. At the higher flow velocity, the design engineer must still account for surge pressures and design accordingly.

Vibration isolation: Due to Fusiolen® PP-R's natural ability to absorb vibration, isolators are not required if the pipe has some limited mobility on either side of the pump.

Pre-formed insulation		
Aquatherm ND	Best fit	Best IPS fit
½"	½" IPS	½"
¾"	¾" IPS	¾"
1"	1" IPS	1"
1 ¼"	1 ½" CTS	1 ¼"
1 ½"	1 ½" IPS	1 ½"
2"	2" IPS	2"
2 ½"	2 ½"	2 ½"
3"	3" CTS	3"
3 ½"	4" IPS	4"
4"	5" CTS	5"
6"	6" IPS	6"
8"	8" CTS	8"
10"	10" CTS	10"
12"	12" IPS	12"

UV protection and painting

UV radiation can damage and weaken PP-R chains over time. Avoid exposing Aquatherm pipe and fittings to UV radiation.

Transport and storage: Aquatherm pipes come in UV-resistant bags for storage and transport. Leave the pipes in these bags until you are ready to install them.

Installation: Aquatherm offers its pipes with an extruded UV protective layer. This upgrade is ideal for UV protection because it does not require maintenance. However, extra preparation is needed for installation (see 4.38).

Another option is to paint the pipe. Painted pipe may need to be recoated or maintained. Aquatherm recommends using an elastomeric paint, which will expand and contract with the pipes. Visit aquatherm.com/ancillary-products for paint options.

You may also paint the pipe for non-UV reasons. Standard acrylic, enamel, epoxy, and latex paints do not harm the pipe. Painting the pipe is considered an aftermarket modification and Aquatherm does not assume any responsibility for the performance of the paint.

Fusing UV pipe

In order to fuse the Aquatherm UV protected pipe, you will need to remove the outer layer. The outer layer is a black polyethylene and it is factory extruded over the top of normal **aquatherm green pipe®** and **aquatherm blue pipe®** pipes. You will still need to cover or paint the fittings.

Mark the pipe one size up from its actual size. This will protect the black layer from the heat fusion process.

Cut around the outside of the pipe through just the black layer. A rolling cutter works well. Do not cut into the pipe wall.

Cut from the mark to the edge of the pipe. Wear protective gloves and mind your fingers.

Use a knife to pry up the edge of the black layer. Re-score the cuts if they are not deep enough.

Peel back and remove the black layer. Fuse the pipe following the normal guidelines.

Flushing, grounding, and freeze protection

Flushing: Before beginning operation, flush the system to remove dust, pipe shavings, and other particles that may have fallen into the pipe. Make sure the system is flushed in a safe manner that doesn't damage or clog any components. Unless otherwise required, water is sufficient for flushing out the system.

Grounding: Most building codes require that grounding be provided for all conductive components inside the structure. It is important to note that Aquatherm pipes do not carry electrical currents and cannot be used to provide grounding. Where metal pipes are replaced by PP-R pipes, the ground cannot be created by the piping system. An alternative ground system must be installed.

Freeze protection: Aquatherm piping systems can be installed in applications and conditions where freezing may occur. Generally, freezing the pipes and the water in them will not cause problems for the piping materials, but they should not be frozen intentionally. Maintaining a minimum flow can prevent the pipes from freezing solid.

All freeze protection products must be used in accordance with the manufacturer's recommendations, the product listings, and in compliance with all applicable local codes. When using any type of external heat source applied to the piping such as heat tape or heating cables, the product must be suitable for use with plastic piping. Additionally, the heat system must be self-regulating and the surface temperature of the Aquatherm pipe and fittings must not exceed 160 °F (71 °C).

Warranty claims

For any claims on the warranty, you will need to submit the following information using the Warranty Claim Form:

- The installer number(s) of the installer(s)
- A copy of the previously submitted pressure test or the submission date
- Pictures and/or samples of the damaged pipe (samples preferred)
- Information regarding operating pressures and temperatures leading up to the failure
- Additional information as specified on the Warranty Claim Form

This information will be submitted to Aquatherm NA, and after testing and review, be forwarded on to Aquatherm GmbH for final analysis. This process may take several weeks. Appropriate coverage will be determined and issued accordingly. Submission for analysis is not a guarantee of compensation. Please note that the Aquatherm warranty does not cover the following issues*:

- Improperly assembled transitions (threads, flanges, copper stub outs, PEX, etc.) unless the fitting was defective.
- Time lost due to poor planning, supplier issues, or failure to order the proper parts/tools.
- Connections that have not been properly fused according to Aquatherm's requirements.
- Failures in systems that were not pressure tested before operation (evaluated on a case-by-case basis).
- Handling damage to pipe or fittings after they have left Aquatherm's possession.
- Use of defective tools and equipment to make welded joints or fittings connections.

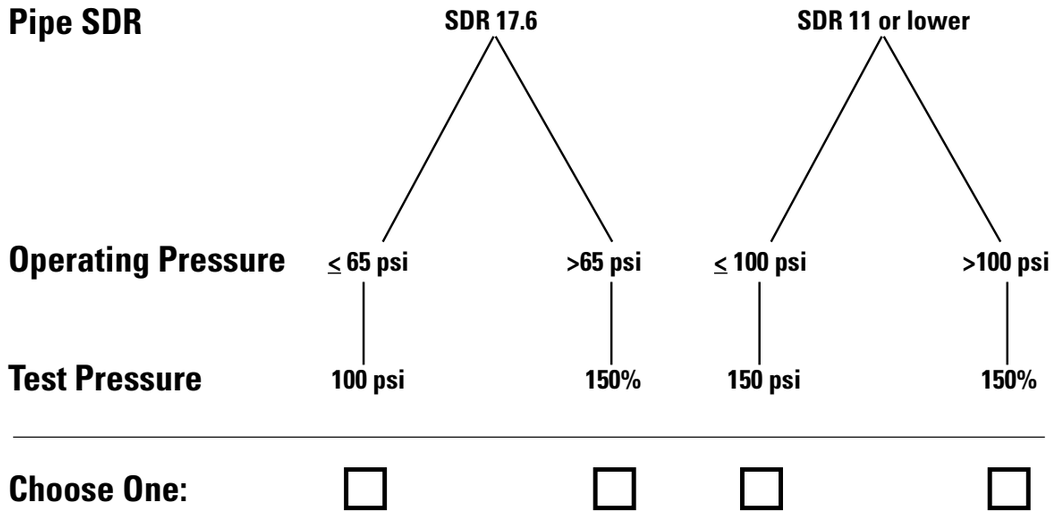
*This list is not comprehensive.

Pressure testing *(page 1 of 13)*

Aquatherm offers an extensive warranty to protect against damages caused by failure from manufacturer's defect. Aquatherm requires that all installations be pressure tested in accordance with the following instructions and that proof of the pressure test be submitted to Aquatherm before the coverage can go into effect. Warranty coverage begins only after the pressure test is properly completed and submitted. Aquatherm's warranty does not cover failures caused by improper installation, operation outside of the recommended parameters, or damage from mishandling after the pipe has left the manufacturer.

Step 1: Determine your testing pressure. In order to ensure the integrity of the heat fusion connections, a pressure test must be performed on the completed system. The amount of pressure used depends on the type of pipe and intended pressure of the application.

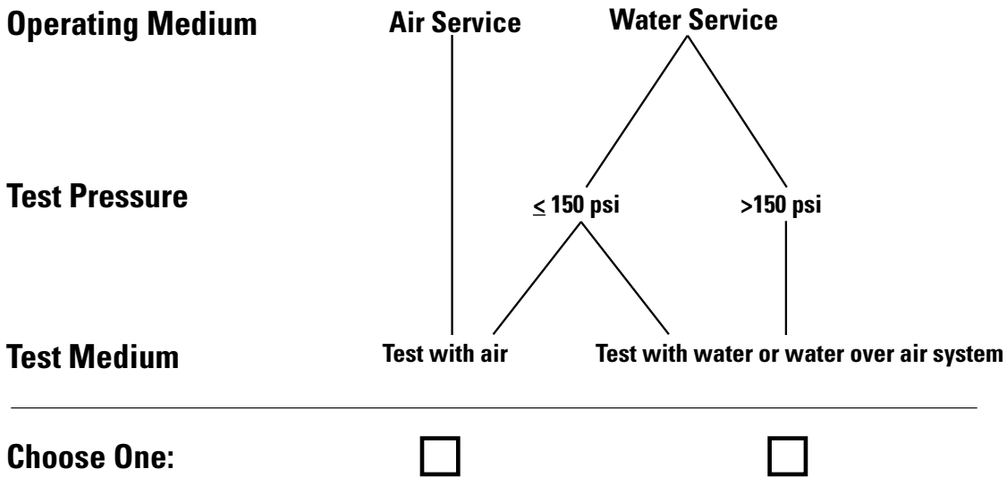
- If the piping system contains SDR 17.6 pipe and has an intended operating pressure of 65 psi or lower, the system must be tested at 100 psi. If the piping system has an intended operating pressure higher than 65 psi, the system must be tested at 150% of the intended operating pressure.
- If the system contains only SDR 11 or heavier-walled pipe (lower SDR) and has an intended operating pressure of 100 psi or less, the system must be tested at 150 psi. If the system has an intended operating pressure higher than 100 psi, the system must be tested at 150% of the intended operating pressure.
- If you have concerns regarding your testing pressure, please contact Aquatherm. Exceptions to the required pressure test must be submitted via letter to Aquatherm.
- If the piping system has a mixture of SDR pipe, the test should be performed to the higher SDR or thinner walled pipe testing requirements. For example, if the piping system contains SDR 17.6 pipe and SDR 11 piping, you should test to the requirements of the SDR 17.6 piping.



Pressure testing *(page 3 of 13)*

Step 2: Determine your testing medium. Water is the preferred medium for testing purposes, due to its incompressibility. However, in low pressure applications, air testing may also be suitable. You may use a different testing medium for different tests, as long as the medium is acceptable with the test pressure.

- If the system is intended for compressed air service, only compressed air may be used for the pressure test, regardless of the following restrictions.
- If the testing pressure is equal to or less than 150 psi, you may test with air only, water only, or with a water over air combination system.
- If the testing pressure exceeds 150 psi, the test must be performed using water only, or water with an air fill. Compressed air alone is not approved for systems with a testing pressure higher than 150 psi, unless those systems are intended for compressed air service.



Pressure testing *(page 5 of 13)*

Step 3: Observe safety protocols. The full Aquatherm warranty does not take effect until the pressure test is completed and submitted and the system is in operation. Therefore, it is important for the tester to observe all safety recommendations from Aquatherm and any other jobsite safey requirements until the testing is complete.

For all systems:

- Visually inspect the connections for signs of proper fusion, following the guidelines given in the Aquatherm Installer Manual. Socket connections should have two even rings of melted plastic, and a visible depth mark. Butt welded connections should have a single bead with a rounded top. This inspection is most easily done during the fusion process. The absence of these signs may be indicative of an improper fusion.
- Remove all fusion equipment from the system before starting the pressure test.
- Set your pressure gauge near the bottom of the system, where the pressure will be highest. This reduces the risk of over-pressurizing the system.
- Observe the joints during the test for any indications of leaks. If a leak is found, relieve all test pressure and repair the leak before continuing.

Pressure testing *(page 6 of 13)*

Step 3 (continued):

When using compressed air:

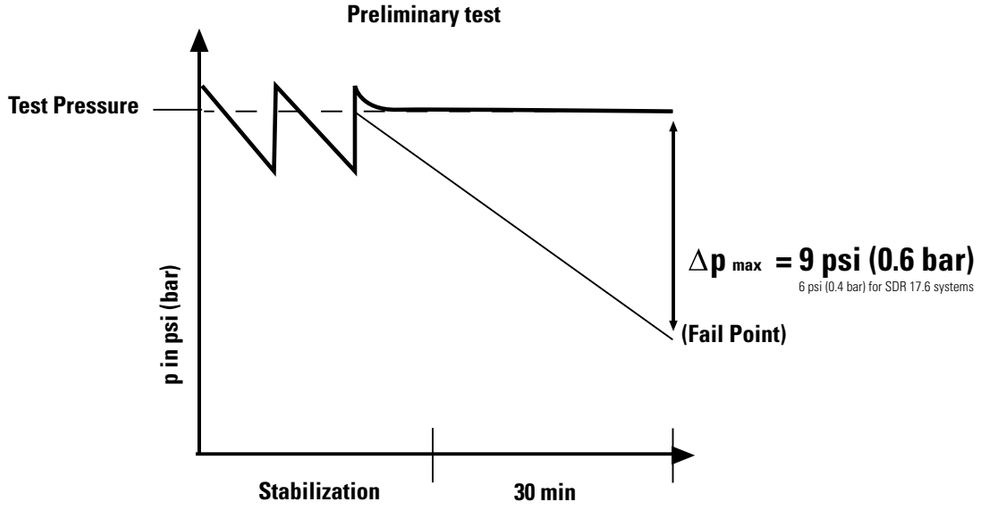
- Stand clear of the pipe during testing and warn others nearby to do the same. Take measures to secure loose sections of the pipe in case a rupture does occur.
- Do not perform the test if the ambient temperature is higher than 100 °F. Use water instead.
- Should any transition joints leak during testing, check the joints for proper assembly and repeat the test using water before replacing any of the fittings.

Pressure testing *(page 7 of 13)*

Step 4: Perform the test. Follow the steps as indicated below. Use a digital pressure test gauge or an analog gauge that is accurate to within 0.5 psi. Record the results on the pressure test form.

Preliminary test:

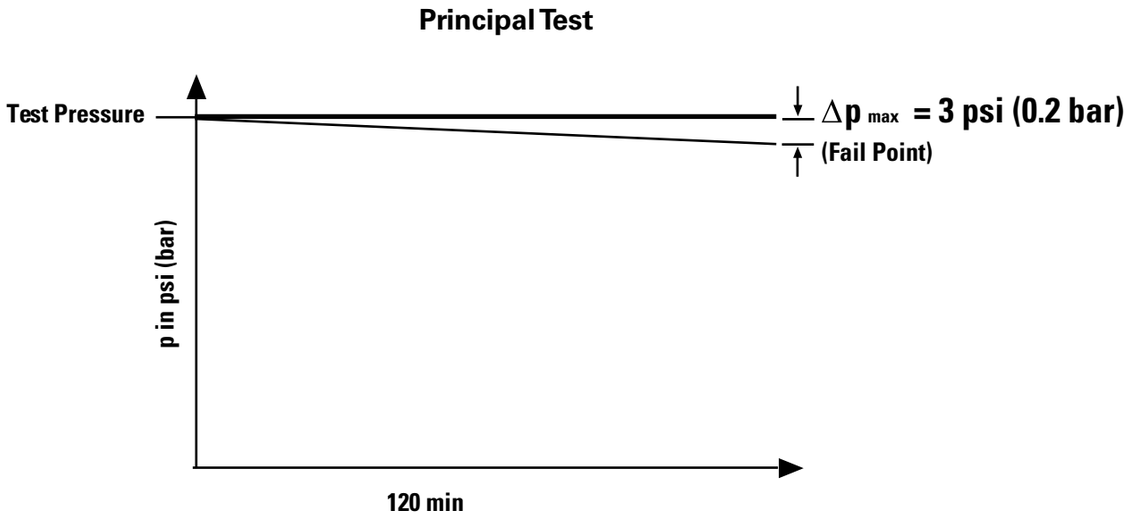
- Bring the system up to the test pressure. The system will expand slightly once it is up to pressure, so additional pressure may be required to help it stabilize.
- Once the system stabilizes, observe it for 30 minutes. The system should be able to hold the test pressure during that time.
- The loss of more than 9 psi (6 psi for SDR 17.6 systems) or steadily decreasing pressure during this test is indicative of a leak. If a leak occurs, identify the leak and repair the system then repeat this test.
- A successful version of this test must be completed before proceeding.
- Aquatherm recommends using this test for progressive testing, rather than completing the entire testing sequence. The entire testing sequence must be completed on the whole system when it is finished.



Step 4 (continued):

Principal test:

- If the system has lost any pressure during the preliminary test, bring the system back up to the test pressure.
- Observe the system for 120 minutes. The system should be able to hold the full test pressure during that time.
- The loss of more than 3 psi or steadily decreasing pressure during this test is indicative of a leak. Identify the leak and repair the system before repeating this test.
- A successful version of this test must be completed before proceeding.



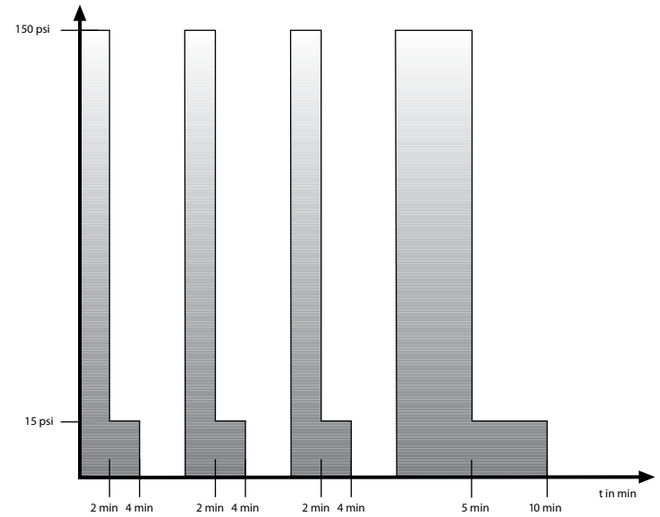
Pressure testing *(page 11 of 13)*

Step 4 (continued):

Final test:

- Release the pressure from the system.
- Bring the system up to test pressure for two minutes. Reduce the system pressure to 15 psi for two minutes.
- Release the pressure from the system.
- Bring the system up to test pressure for two minutes. Reduce the system pressure to 15 psi for two minutes.
- Release the pressure from the system.
- Bring the system up to test pressure for two minutes. Reduce the system pressure to 15 psi for two minutes.
- Release the pressure from the system.
- Bring the system up to test pressure for five minutes. Reduce the system pressure to 15 psi for five minutes.
- Release the pressure from the system.

Pressure testing *(page 12 of 13)*



Pressure testing *(page 13 of 13)*

Step 5: Complete and submit the pressure test record.

- Submit the form to Aquatherm within 30 days of completing the pressure test.
- If you are testing a system in sections, save all the pressure test records and submit them together.
- Include the installer numbers of all the installers who fused connections on the system.

All information can be submitted electronically on Aquatherm's website at http://www.aquatherm.com/pressure-test-submission.

A sample test record and set of instructions for recording in the field is also available on the submission page.

Chapter 5: Pipe and fittings

This chapter includes all the parts that Aquatherm offers as part of its piping systems. This chapter only gives the nominal imperial size so as to avoid confusion. A table giving the metric conversions can be found on page 1.8.

Full dimensional data is not included in this manual. The dimensional data for all Aquatherm parts and fittings can be found on Aquatherm's website.

aquatherm green pipe® SDR 7.4 MF

Part no.	Dimension ND
0670708	½"
0670710	¾"
0670712	1"
0670714	1 ¼"
0670716	1 ½"
0670718	2"
0670720	2 ½"
0670722	3"
0670724	3 ½"
0670726	4"

Part no.	Dimension ND
0670730	6"
0670730x2[a]	6" (Double Length)
0670734	8"
0670734x2[b]	8" (Double Length)
0670738	10"
0670738x2[b]	10" (Double Length)
0670742	12"
0670744	14"

[a]Comes in 26 ft lengths.
[b]Comes in 38 ft lengths.

aquatherm green pipe® SDR 7.4/11 S

Part no.	Dimension ND
0610808	½" SDR 7.4 (non-MF)
0610810	¾" SDR 7.4 (non-MF)
0610212	1"
0610214	1 ¼"
0610216	1 ½"
0610218	2"
0610220	2 ½"
0610222	3"
0610224	3 ½"
0610226	4"
0610226x2[a]	4" (Double Length)
0610226x3[b]	4" (Triple Length)
0610230	6"
0610230x2[c]	6" (Double Length)

[a]Pipe comes in 26 ft lengths.
[b]Pipe comes in 39 ft legnths.
[c]Pipe comes in 38 ft lenghts.

aquatherm green pipe® SDR 7.4/11 S *(continued)*

Part no.	Dimension ND
0610234	8"
0610234x2[c]	8" (Double Length)
0610238	10"
0610238x2[c]	10" (Double Length)
0010242	12"
0010242x2[c]	12" (Double Length)
0010244	14"
0010246[d]	16"
0010248[d]	18"
The following items are supplied in coils:	
0010308	½"
0010310	¾"
0010312	1"

[d]Mechanically stabilized with a faser-composite layer in the center of the pipe.

aquatherm green pipe® SDR 7.4 MF UV

Part no.	Dimension ND
0670758	½"
0670760	¾"
0670762	1"
0670764	1 ¼"
0670766	1 ½"
0670768	2"
0670770	2 ½"

Part no.	Dimension ND
0670772	3"
0670774	3 ½"
0670776	4"
0670780	6"
0670784	8"
0670788	10"

aquatherm blue pipe® SDR 7.4/11 MF

Part no.	Dimension ND
SDR 7.4	
2670708	½"
2670710	¾"
SDR 11	
2670112	1"
2670114	1 ¼"
2670116	1 ½ "
2670118	2"
2670120	2 ½"
2670122	3"
2670124	3 ½"
2670126	4"
2670126x2[a]	4" (Double Length)
2670126x3[b]	4" (Triple Length)
2670130	6"

Part no.	Dimension ND
2670130x2[c]	6" (Double Length)
2670134	8"
2670134x2[c]	8" (Double Length)
2670138	10"
2670138x2[c]	10" (Double Length)
2070142	12"
207142x2[c]	12" (Double Length)
2070144	14"
2070144x2[c]	14" (Double Length)
2070146	16"
2070148	18"
The following items are supplied in coils (non-faser)	
2010308	½"
2010310	¾"
2010312	1"

[a]Pipe comes in 26 ft lengths.
[b]Pipe comes in 39 ft legnths.
[c]Pipe comes in 38 ft lenghts.

aquatherm blue pipe® SDR 17.6 MF

Part no.	Dimension ND
2570126	4"
2570126x2[a]	4" (Double Length)
2570126x3[b]	4" (Triple Length)
2570130	6"
2570130x2[c]	6" (Double Length)
2570134	8"
2570134x2[c]	8" (Double Length)
2570138	10"
2570138x2[c]	10" (Double Length)
2570142	12"
2570142x2[c]	12" (Double Length)
2570144	14"
2570144x2[c]	14" (Double Length)
2570146	16"
2570146x2[c]	16" (Double Length)

Part no.	Dimension ND
2570148	18"
2570148x2[c]	18" (Double Length)
2570150	20"
2570150x2[c]	20" (Double Length)
2570152	22"
2570154	24"
2570154x2[c]	24" (Double Length)

[a]Pipe comes in 26 ft lengths.
[b]Pipe comes in 39 ft legnths.
[c]Pipe comes in 38 ft lenghts.

aquatherm blue pipe® SDR 7.4/11 MF UV

Part no.	Dimension ND
2670758	½″ — SDR 7.4
2670760	¾″ — SDR 7.4
2670162	1″ — SDR 11
2670164	1 ¼″ — SDR 11
2670166	1 ½″ — SDR 11
2670168	2″ — SDR 11
2670170	2 ½″ — SDR 11
2670172	3″ — SDR 11

Part no.	Dimension ND
2670174	3 ½″ — SDR 11
2670176	4″ — SDR 11
2670180	6″ — SDR 11
2670184	8″ — SDR 11
2670188	10″ — SDR 11

aquatherm blue pipe® SDR 17.6 MF UV

Part no.	Dimension ND
2570180	6″
2570184	8″
2570188	10″
2570192	12″
2570194	14″
2570196	16″
2570198	18″
2570200	20″

Part no.	Dimension ND
2570202	22″
2570204	24″

aquatherm lilac pipe® SDR 7.4/11 S

Part no.	Dimension ND
SDR 7.4	
9010808	½″
9010810	¾″
SDR 11	
9010212	1″
9010214	1 ¼″
9010216	1 ½″
9010218	2″

Part no.	Dimension ND
9010220	2 ½″
9010222	3″
9010224	3 ½″
9010226	4″
9010226x2[a]	4″ (Double Length)
9010226x3[b]	4″ (Triple Length)
9010230	6″
9010230x2[c]	6″ (Double Length)
9010234	8″
9010238	10″

[a]Pipe comes in 26 ft lengths.
[b]Pipe comes in 39 ft legnths.
[c]Pipe comes in 38 ft lenghts.

Coupling

Part no.	Dimension ND
0111008	½"
0111010	¾"
0111012	1"
0111014	1¼"
0111016	1½"
0111018	2"
0111020	2½"
0111022	3"
0111024	3½"
0111026	4"

Reducing couplings
female/female

Part no.	Dimension ND
0111222	1 ¼" to 1"
0111228	1 ½" to 1"
0111230	1 ½" to 1 ¼"
0111236	2" to 1 ¼"
0111238	2" to 1 ½"
0111240	2 ½" to 1 ½"
0111242	2 ½" to 2"
0111252	3" to 2"

Part no.	Dimension ND
0111253	3" to 2 ½"
0111257	3 ½" to 2 ½"
0111259	3 ½" to 3"
0111263	4" to 3"
0111265	4" to 3 ½"

Cross-over

Part no.	Dimension ND
0116108	½"
0116110	¾"
0116112	1"

Street 45°
female/male

Part no.	Dimension ND
0112708	½"
0112710	¾"
0112712	1"
0112714	1 ¼"

Street 90°
female/male

Part no.	Dimension ND
0112308	½"
0112310	¾"
0112312	1"
0112314	1 ¼"

Bushing

Part no.	Dimension ND
0111112	¾″ to ½″
0111114	1″ to ½″
0111116	1″ to ¾″
0111118	1 ¼″ to ½″
0111120	1 ¼″ to ¾″
0111122	1 ¼″ to 1″
0111124	1 ½″ to ½″
0111126	1 ½″ to ¾″
0111128	1 ½″ to 1″

Part no.	Dimension ND
0111130	1 ½″ to 1 ¼″
0111131	2″ to ½″
0111132	2″ to ¾″
0111134	2″ to 1″
0111136	2″ to 1 ¼″
0111138	2″ to 1 ½″
0111143	2 ½″ to ½″
0111144	2 ½″ to ¾″
0111145	2 ½″ to 1″
0111139	2 ½″ to 1 ¼″
0111140	2 ½″ to 1 ½″
0111142	2 ½″ to 2″
0111151	3″ to 1 ½″
0111152	3″ to 2″
0111153	3″ to 2 ½″

Part no.	Dimension ND
0111155	3 ½″ to 2″
0111157	3 ½″ to 2 ½″
0111159	3 ½″ to 3″
0111161	4″ to 2 ½″
0111163	4″ to 3″
0111165	4″ to 3 ½″

Cross

Part no.	Dimension ND
0113708	½″
0113710	¾″
0113712	1″
0113714	1 ¼″

Butt weld reducer

SDR	Part no.	Dimension ND
7.4	0111184	8″ to 6″
	0111188	10″ to 6″
	0111190	10″ to 8″
	0111192	12″ to 8″
	0111194	12″ to 10″
	0111196	14″ to 10″
	0111198	14″ to 12″

SDR	Part no.	Dimension ND
11	0111185	8″ to 6″
	0111189	10″ to 6″
	0111191	10″ to 8″
	0111193	12″ to 8″
	0111195	12″ to 10″
	0111197	14″ to 10″
	0111199	14″ to 12″
	0111201	16″ to 10″
	0111203	16″ to 12″
	0111204	16″ to 14″
	0111206	18″ to 12″
	0111207	18″ to 14″
	0111208	18″ to 16″

SDR	Part no.	Dimension ND
17.6	2511184	8″ to 6″
	2511188	10″ to 6″
	2511190	10″ to 8″
	2511193	12″ to 8″
	2511195	12″ to 10″
	2511197	14″ to 10″
	2511199	14″ to 12″
	2511201	16″ to 10″
	2511203	16″ to 12″
	2511204	16″ to 14″
	2511206	18″ to 12″
	2511207	18″ to 14″
	2511208	18″ to 16″
	2511209	20″ to 12″
	2511210	20″ to 14″

SDR	Part no.	Dimension ND
17.6	2511211	20″ to 16″
	2511212	20″ to 18″
	2511213	22″ to 16″
	2511214	22″ to 18″
	2511215	22″ to 20″
	2511216	24″ to 16″
	2511217	24″ to 18″
	2511218	24″ to 20″
	2511219	24″ to 22″

Reducing coupling
butt weld/socket weld

SDR	Part no.	Dimension ND
7.4	0111174	6″ to 3 ½″
	0111176	6″ to 4″
	0111182	8″ to 4″
11	0111175	6″ to 3 ½″
	0111177	6″ to 4″
	0111183	8″ to 4″

SDR	Part no.	Dimension ND
17.6	2511174	6″ to 3 ½″
	2511176	6″ to 4″
	2511182	8″ to 4″

One side is socket welded and the other is butt welded.

Elbow 90° (Socket)

Part no.	Dimension ND
0112108	½″
0112110	¾″
0112112	1″
0112114	1 ¼″
0112116	1 ½″
0112118	2″
0112120	2 ½″
0112122	3″
0112124	3 ½″
0112126	4″

aquatherm green pipe® Elbow 90° SD (Butt-weld)

SDR	Part no.	Dimension ND
7.4	7312130	6″
	7312134	8″
	7312138	10″
	7312142	12″
	7312144	14″

SDR	Part no.	Dimension ND
11	7112130	6″
	7112134	8″
	7112138	10″
	7112142	12″
	7112144	14″
	7112146	16″
	7112148	18″

Elbow 90° (Butt-weld)
molded

SDR	Part no.	Dimension No.
7.4	0112130	6″
11	0112131	6″

Elbow 45° (Socket)

Part no.	Dimension ND
0112508	½″
0112510	¾″
0112512	1″
0112514	1 ¼″
0112516	1 ½″
0112518	2″
0112520	2 ½″
0112522	3″
0112524	3 ½″
0112526	4″

aquatherm green pipe® Elbow 45° SD (Butt-weld)

SDR	Part no.	Dimension ND
7.4	7312530	6″
	7312534	8″
	7312538	10″
	7312542	12″
	7312544	14″

SDR	Part no.	Dimension ND
11	7112530	6″
	7112534	8″
	7112538	10″
	7112542	12″
	7112544	14″
	7112546	16″
	7112548	18″

Elbow 45° (Butt-weld)
(molded)

SDR	Part no.	Dimension ND
7.4	0112530	6″
11	0112531	6″

aquatherm blue pipe® Elbow 90° SD (Butt-weld)

SDR	Part no.	Dimension ND
11	7512130	6″
	7512134	8″
	7512138	10″
	7512142	12″
	7512144	14″
	7512146	16″
	7512148	18″

SDR	Part no.	Dimension ND
17.6	7412130	6″
	7412134	8″
	7412138	10″
	7412142	12″
	7412144	14″
	7412146	16″
	7412148	18″
	7412150	20″
	7412152	22″
	7412154	24″

aquatherm blue pipe® Elbow 45° SD (Butt-weld)

SDR	Part no.	Dimension ND
11	7512530	6″
	7512534	8″
	7512538	10″
	7512542	12″
	7512544	14″
	7512546	16″
	7512548	18″

SDR	Part no.	Dimension ND
17.6	7412530	6″
	7412534	8″
	7412538	10″
	7412542	12″
	7412544	14″
	7412546	16″
	7412548	18″
	7412550	20″
	7412552	22″
	7412554	24″

End cap (Socket)

Part no.	Dimension ND
0114108	½″
0114110	¾″
0114112	1″
0114114	1 ¼″
0114116	1 ½″
0114118	2″
0114120	2 ½″
0114122	3″
0114124	3 ½″
0114126	4″

End cap (Butt-weld)

SDR	Part no.	Dimension ND
7.4	0114130	6″
	0114134	8″
	0114138	10″
	0114142	12″
	0114144	14″

SDR	Part no.	Dimension ND
11	0114131	6″
	0114135	8″
	0114139	10″
	0114143	12″
	0114145	14″
	0114147	16″
	0114149	18″

SDR	Part no.	Dimension ND
17.6	2514130	6″
	2514134	8″
	2514138	10″
	2514142	12″
	2514144	14″
	2514146	16″
	2514148	18″
	2514150	20″
	2514152	22″
	2514154	24″

aquatherm green pipe® Wye (Lateral 45)

SDR	Part no.	Dimension ND
7.4	2303726	4″
	2303730	6″
	2303734	8″
	2303738	10″

SDR	Part no.	Dimension ND
11	2103126	4″
	2103130	6″
	2103134	8″
	2103138	10″

aquatherm blue pipe® Wye (Lateral 45)

SDR	Part no.	Dimension ND
11	2503126	4″
	2503130	6″
	2503134	8″
	2503138	10″

SDR	Part no.	Dimension ND
17.6	2403126	4″
	2403130	6″
	2403134	8″
	2403138	10″

Tee (Socket)

Part no.	Dimension ND
0113108	½″
0113110	¾″
0113112	1″
0113114	1 ¼″
0113116	1 ½″
0113118	2″
0113120	2 ½″
0113122	3″
0113124	3 ½″
0113126	4″

aquatherm green pipe® Tee (Butt-weld)

SDR	Part no.	Dimension ND
7.4	0113130MF	6″
	0113134	8″
	0113138	10″
	0113142	12″
	0113144	14″

SDR	Part no.	Dimension ND
11	0113131MF	6″
	0113135	8″
	0113139	10″
	0113143	12″
	0113145	14″
	0113147[a]	16″
	0113149[a]	18″

[a]Mechanically stabilized with a faser-composite layer in the center of the pipe.

Tee (Butt-weld) molded

SDR	Part no.	Dimension No.
7.4	0113130	6"
	0113130LG[a]	6"
11	0113131	6"
	0113131LG[a]	6"

[a]Comes with a 1-ft extension on each end.

aquatherm green pipe® Reducing tee (Butt-weld)

SDR	Part no.	Dimension ND
7.4	0113604	6" x 6" x 4"
	0113618	8" x 8" x 6"
	0113634	10" x 10" x 6"
	0113640	10" x 10" x 8"
	0113908	12" x 12" x 8"
	0113910	12" x 12" x 10"
	0113922	14" x 14" x 10"
	0113924	14" x 14" x 12"

SDR	Part no.	Dimension ND
11	0113605	6" x 6" x 4"
	0113619	8" x 8" x 6"
	0113635	10" x 10" x 6"
	0113641	10" x 10" x 8"
	0113655	12" x 12" x 8"
	0113657	12" x 12" x 10"
	0113669	14" x 14" x 10"
	0113671	14" x 14" x 12"
	0113684[a]	16" x 16" x 12"
	0113685[a]	16" x 16" x 14"
	0113699[a]	18" x 18" x 14"
	0113700[a]	18" x 18" x 16"

[a]Mechanically stabilized with a faser-composite layer in the center of the pipe.

Reducing tee (Socket)

inlet, outlet, branch

Part no.	Dimension ND
0113511	½" x ½" x ¾"
0113520	¾" x ½" x ½"
0113522	¾" x ¾" x ½"
0113532	1" x ½" x ½"
0113534	1" x 1" x ½"
0113538	1" x ¾" x ¾"
0113540	1" x 1" x ¾"
0113542	1 ¼" x 1 ¼" x ½"
0113544	1 ¼" x 1 ¼" x ¾"

Part no.	Dimension ND
0113546	1 ¼" x 1 ¼" x 1"
0113547	1 ½" x 1 ½" x ½"
0113548	1 ½" x 1 ½" x ¾"
0113550	1 ½" x 1 ½" x 1"
0113551	1 ½" x 1 ½" x 1 ¼"
0113552	2" x 2" x ½"
0113554	2" x 2" x ¾"
0113556	2" x 2" x 1"
0113558	2" x 2" x 1 ¼"
0113560	2" x 2" x 1 ½"
0113561	2 ½" x 2 ½" x ½"
0113562	2 ½" x 2 ½" x ¾"
0113564	2 ½" x 2 ½" x 1"
0113566	2 ½" x 2 ½" x 1 ¼"

Part no.	Dimension ND
0113568	2 ½" x 2 ½" x 1 ½"
0113570	2 ½" x 2 ½" x 2"
0113576	3" x 3" x 1"
0113578	3" x 3" x 1 ¼"
0113580	3" x 3" x 1 ½"
0113582	3" x 3" x 2"
0113584	3" x 3" x 2 ½"
0113586	3 ½" x 3 ½" x 2"
0113588	3 ½" x 3 ½" x 2 ½"
0113590	3 ½" x 3 ½" x 3"
0113592	4" x 4" x 2 ½"
0113594	4" x 4" x 3"
0113596	4" x 4" x 3 ½"

aquatherm green pipe® Reducing Tee (Socket)

SDR	Part no.	Dimension ND
7.4	0113600	6″ x 6″ x 2 ½″
	0113602	6″ x 6″ x 3″
	0113608	8″ x 8″ x 2 ½″
	0113610	8″ x 8″ x 3″
	0113612	8″ x 8″ x 3 ½″
	0113614	8″ x 8″ x 4″
	0113624	10″ x 10″ x 2 ½″
	0113626	10″ x 10″ x 3″
	0113628	10″ x 10″ x 3 ½″
	0113630	10″ x 10″ x 4″
	0113904	12″ x 12″ x 4″
	0113906[a]	12″ x 12″ x 6″
	0113916	14″ x 14″ x 4″
	0113918	14″ x 14″ x 6″
	0113920[a]	14″ x 14″ x 8″

[a] Branch outlet has a butt-weld connection.

SDR	Part no.	Dimension ND
11	0113601	6″ x 6″ x 2 ½″
	0113603	6″ x 6″ x 3″
	0113609	8″ x 8″ x 2 ½″
	0113611	8″ x 8″ x 3″
	0113613	8″ x 8″ x 3 ½″
	0113615	8″ x 8″ x 4″
	0113625	10″ x 10″ x 2 ½″
	0113627	10″ x 10″ x 3″
	0113629	10″ x 10″ x 3 ½″

SDR	Part no.	Dimension ND
11	0113631	10″ x 10″ x 4″
	0113651	12″ x 12″ x 4″
	0113653[a]	12″ x 12″ x 6″
	0113663	14″ x 14″ x 4″
	0113665[ab]	14″ x 14″ x 6″
	0113667[a]	14″ x 14″ x 8″
	0113676[b]	16″ x 16″ x 4″
	0113678[ab]	16″ x 16″ x 6″
	0113680[ab]	16″ x 16″ x 8″
	0113682[ab]	16″ x 16″ x 10″
	0113690	18″ x 18″ x 4″
	0113692[ab]	18″ x 18″ x 6″
	0113694[ab]	18″ x 18″ x 8″
	0113696[ab]	18″ x 18″ x 10″
	0113698[ab]	18″ x 18″ x 12″

[a] Branch outlet has a butt-weld connection.
[b] Mechanically stabilized with a faser-composite layer in the center of the pipe.

aquatherm blue pipe® Tee (Butt-weld)

SDR	Part no.	Dimension ND
11	2613131	6″
	2613135	8″
	2613139	10″
	2013143	12″
	2013145	14″
	2013147	16″
	2013149	18″

SDR	Part no.	Dimension ND
17.6	2513130	6″
	2513134	8″
	2513138	10″
	2513142	12″
	2513144	14″
	2513146	16″
	2513148	18″
	2513150	20″
	2513152	22″
	2513154	24″

aquatherm blue pipe® - Reducing tee (Butt-weld)

SDR	Part no.	Dimension ND
11	2613605	6″ x 6″ x 4″
	2613619	8″ x 8″ x 6″
	2613635	10″ x 10″ x 6″
	2613641	10″ x 10″ x 8″
	2013655	12″ x 12″ x 8″
	2013657	12″ x 12″ x 10″
	2013669	14″ x 14″ x 10″

SDR	Part no.	Dimension ND
11	2013671	14″ x 14″ x 12″
	2013684	16″ x 16″ x 12″
	2013685	16″ x 16″ x 14″
	2013699	18″ x 18″ x 14″
	2013700	18″ x 18″ x 16″

aquatherm blue pipe® - Reducing tee (Butt-weld) *(continued)*

SDR	Part no.	Dimension ND
17.6	2513604[a]	6″ x 6″ x 4″
	2513618	8″ x 8″ x 6″
	2513634	10″ x 10″ x 6″
	2513640	10″ x 10″ x 8″
	2513657	12″ x 12″ x 10″
	2513669	14″ x 14″ x 10″
	2513671	14″ x 14″ x 12″
	2513684	16″ x 16″ x 12″

SDR	Part no.	Dimension ND
17.6	2513685	16″ x 16″ x 14″
	2513699	18″ x 18″ x 14″
	2513700	18″ x 18″ x 16″
	2513813	20″ x 20″ x 14″
	2513814	20″ x 20″ x 16″
	2513815	20″ x 20″ x 18″
	2513831	22″ x 22″ x 16″
	2513832	22″ x 22″ x 18″
	2513833	22″ x 22″ x 20″
	2513849	24″ x 24″ x 16″
	2513850	24″ x 24″ x 18″
	2513851	24″ x 24″ x 20″
	2513852	24″ x 24″ x 22″

aquatherm blue pipe® Reducing tee (Socket)

SDR	Part no.	Dimension ND
11	2613601	6″ x 6″ x 2 ½″
	2613603	6″ x 6″ x 3″
	2613609	8″ x 8″ x 2 ½″
	2613611	8″ x 8″ x 3″
	2613613	8″ x 8″ x 3 ½″
	2613615	8″ x 8″ x 4″

SDR	Part no.	Dimension ND
11	2613625	10″ x 10″ x 2 ½″
	2613627	10″ x 10″ x 3″
	2613629	10″ x 10″ x 3 ½
	2613631	10″ x 10″ x 4″
	2013651	12″ x 12″ x 4″
	2013653[a]	12″ x 12″ x 6″
	2013663	14″ x 14″ x 4″
	2013665[a]	14″ x 14″ x 6″
	2013667[a]	14″ x 14″ x 8″
	2013676	16″ x 16″ x 4″
	2013678[a]	16″ x 16″ x 6″
	2013680[a]	16″ x 16″ x 8″

SDR	Part no.	Dimension ND
11	2013682[a]	16″ x 16″ x 10″
	2013690	18″ x 18″ x 4″
	2013692[a]	18″ x 18″ x 6″
	2013694[a]	18″ x 18″ x 8″
	2013696[a]	18″ x 18″ x 10″
	2013698[a]	18″ x 18″ x 12″

[a]Branch outlet has a butt-weld connection.

aquatherm blue pipe® - Reducing tee (Socket) *(continued)*

SDR	Part no.	Dimension ND
17.6	2513600	6″ x 6″ x 2 ½″
	2513602	6″ x 6″ x 3″
	2513608	8″ x 8″ x 2 ½″
	2513610	8″ x 8″ x 3″
	2513612	8″ x 8″ x 3 ½″
	2513614	8″ x 8″ x 4″
	2513624	10″ x 10″ x 2 ½″
	2513626	10″ x 10″ x 3″
	2513628	10″ x 10″ 3 ½″

SDR	Part no.	Dimension ND
17.6	2513630	10″ x 10″ x 4″
	2513651	12″ x 12″ x 4″
	2513653[a]	12″ x 12″ x 6″
	2513663	14″ x 14″ x 4″
	2513665[a]	14″ x 14″ x 6″
	2513667[a]	14″ x 14″ x 8″
	2513676	16″ x 16″ x 4″
	2513678[a]	16″ x 16″ x 6″
	2513680[a]	16″ x 16″ x 8″
	2513682[a]	16″ x 16″ x 10″
	2513690	18″ x 18″ x 4″
	2513692[a]	18″ x 18″ x 6″
	2513694[a]	18″ x 18″ x 8″
	2513696[a]	18″ x 18″ x 10″
	2513698[a]	18″ x 18″ x 12″

SDR	Part no.	Dimension ND
17.6	2513804	20″ x 20″ x 4″
	2513806[a]	20″ x 20″ x 6″
	2513808[a]	20″ x 20″ x 8″
	2513810[a]	20″ x 20″ x 10″
	2513812[a]	20″ x 20″ x 12″
	2513821	22″ x 22″ x 4″
	2513839	24″ x 24″ x 4″
	2513841[a]	24″ x 24″ x 6″
	2513843[a]	24″ x 24″ x 8″
	2513845[a]	24″ x 24″ x 10″
	2513847[a]	24″ x 24″ x 12″

[a]Branch outlet has a butt-weld connection.

Fusion outlet (Socket)

Part no.	Dimension ND (pipe x outlet)
0115156	1 ¼" x ½"
0115158	1 ¼" x ¾"
0115160	1 ½" x ½"
0115162	1 ½" x ¾"
0115164	2 x ½"
0115166	2" x ¾"
0115168	2" x 1"
0115170	2 ½" x ½"

Part no.	Dimension ND (pipe x outlet)
0115172	2 ½" x ¾"
0115174	2 ½" x 1"
0115175	2 ½" x 1 ¼"
0115176	3" x ½"
0115178	3" x ¾"
0115180	3" x 1"
0115181	3" x 1 ¼"
0115182	3 ½" x ½"
0115184	3 ½" x ¾"
0115186	3 ½" x 1"
0115188	3 ½" x 1 ¼"
0115189	3 ½" x 1 ½"
0115190	4" x ½"
0115192	4" x ¾"

Part no.	Dimension ND (pipe x outlet)
0115194	4" x 1"
0115196	4" x 1 ¼"
0115197	4" x 1 ½"
0115198	4" x 2"
0115206	6" x ½"
0115208	6" x ¾"
0115210	6" x 1"
0115212	6" x 1 ¼"
0115214	6" x 1 ½"
0115216	6" x 2"
0115218	6" x 2 ½"
0115220	6" x 3"
0115228	8 to 10" x ½"
0115229	8 to 10" x ¾"

Part no.	Dimension ND (pipe x outlet)
0115230	8 to 10" x 1"
0115231	8" x 1 ¼"
0115232	8" x 1 ½"
0115233	8" x 2"
0115234	8" x 2 ½"
0115235	8" x 3"
0115236	8" x 3 ½"
0115237	8" x 4"
0115251	10" x 1 ¼"
0115252	10" x 1 ½"
0115253	10" x 2"
0115254	10" x 2 ½"
0115255	10" x 3"
0115256	10" x 3 ½"

Part no.	Dimension ND (pipe x outlet)
0115257	10" x 4"
0115260	12" to 14" x 2"
0115261	12" to 14" x 2 ½"
0115262	12" x 3"
0115263	12" x 3 ½"
0115264	12" x 4"
0115268	14" x 3"
0115269	14" x 3 ½"
0115270	14" x 4"
0115275	16" to 20" x 2 ½"
0115277	16" to 18" x 3 ½"
0115278	16" x 4"
0115288	16" to 20" x 3"
0115290	18" to 20" x 4"
0115300	16" to 24" x 2"

Part no.	Dimension ND (pipe x outlet)
0115303	20" to 22" x 3 ½"
0115315	22" to 24" x 2 ½"
0115316	22" to 24" x 3"
0115318	22" to 24" x 4"
0115331	24" x 3 ½"

Fusion outlet (Butt-weld)

Part no.	Dimension ND (pipe x outlet)
0115265	12" x 6"
0115271	14" x 6"
0115272	14" x 8"
0115280	16" x 6" to 10"
0115292	18" x 6" to 10"
0115298	18" x 12"
0115306	20" x 6" to 10"
0115312	20" x 12"
0115334	24" x 6" to 10"
0115340	24" x 12"

Flange ring

Part no.	Nominal flange size	Dimension ND	# of bolt holes
3315712	1″	1″	4
3315714	1 ¼″	1 ¼″	4
3315716	1 ½″	1 ½″	4
3315718	2″	2″	4
3315720	2 ½″	2 ½″	4
3315722	3″	3″	8
3315724	3 ½″	3 ½″	8

Part no.	Nominal flange size	Dimension ND	# of bolt holes
3315726	4″	4″	8
3315730	6″	6″	8
3315734	8″	8″	8
3315738	10″	10″	12
3315742	12″	12″	12
3315744	14″	14″	12
3315746	16″	16″	16
3315748	18″	18″	16
3315750	20″	20″	20
3315752	22″	22″	20
3315754	24″	24″	20

Flange adapter

Part no.	Dimension ND
0115512	1″
0115514	1 ¼″
0115516	1 ½″
0115518	2″
0115520	2 ½″
0115522	3″
0115524	3 ½″
0115526[a]	4″

SDR	Butterfly Valve Part no.	Dimension ND — OD
7.4	0115530BV	6″
	0115530LBV[b]	6″
	0115534BV	8″
	0115538BV	10″
	0115542BV	12″
	0115544BV	14″
11	0115531BV	6″
	0115531LBBV[c]	6″
	115531LGBV[b]	6″
	0115535BV	8″
	0115539BV	10″
	0115543BV	12″
	0115545BV	14″
	0115547BV	16″
	0115549BV	18″

SDR	Part no.	Dimension ND — OD
17.6	2915530BV	6″
	2915534BV	8″
	2915538BV	10″
	2915542BV	12″
	2915544BV	14″
	2915546BV	16″
	2915548BV	18″
	2915550BV	20″
	2915552[d]	22″
	2915554BV	24″

[a]Part no. 0115526 must be paired with a coupling (part no. 0111026, sold separately).
[b]Includes 1-ft extension of **aquatherm green pipe**.
[c]Includes 1-ft extension of **aquatherm blue pipe**.
[d]Not butterfly valve compatible.

Pump flange adapter ring
American bolt pattern

Part no.	Dimension ND — OD
5515712	1" (32 mm) pump flange ring - blue, 3-1/8" to 3-5/32" bolt center used with #0115512
5515713	1.25" (40 mm) pump flange ring - black, 3-1/8" to 3-5/32" bolt center used with #0115514
5515714	1.25" (40 mm) pump flange ring - green, 3-/16" to 3-1/2" bolt center used with #0115514, fitted Grundfos model UP4375

Union with brass nut

Part no.	Dimension ND
0115812	1"
0115814	1 ¼"
0115816	1 ½"
0115818	2"
0115820	2 ½"

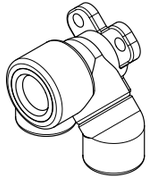
Union with PP-R nut

Part no.	Dimension ND
0115838	½"
0115840	¾"
0115842	1"
0115844	1 ¼"
0115846	1 ½"
0115848	2"
0115850	2 ½"

Flow through back plate elbow 90°

Part No.	Dimension
20197	20 mm x 1/2" IG x 20 mm

Flow through back plate elbow parallel



Part No.	Dimension
20198	20 mm x 1/2" IG x 20 mm

Wing back 90° elbow

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension
0120158	0920158	0620158	20 mm x ½″ F

Electrofusion coupling

Part no.	Dimension ND
0117208	½″
0117210	¾″
0117212	1″
0117214	1 ¼″
0117216	1 ½″
0117218	2″
0117220	2 ½″

Part no.	Dimension ND
0117222	3″
0117224	3 ½″
0117226	4″
0117230[a]	6″
0117234[a]	8″
0117238[a]	10″

[a]Cannot be used in conjunction with UV pipe.

Back plate elbow
threaded

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x thread type
0120108	0920108	0620108	½″ x ½″ F
0120110	0920110	0620110	½″ x ¾″ F
0120112	0920112	0620112	¾″ x ¾″ F
0120113	0920113	0620113	¾″ x ½″ F

ISO plug for pressure tests
with gasket

Part no.	Dimension
0050708	½″ M
0050710	¾″ M

ISO transition piece
with counter nut, gasket and tension washer

Industrial brass Part no.	Dimension
0120204	20 mm x ½" F x ¾" M

ISO transition elbow
with counter nut, gasket and tension washer

Industrial brass Part no.	Dimension
0120208	20 mm x ½" F x ¾" M
0120209	25 mm x ½" F x ¾" M

ISO transition elbow
for dry construction

Industrial brass Part no.	Dimension (ND — OD)
0120210	20 mm x ½" F x ¾" M

Transition piece
round (female)

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x thread type
0121008	0921008	0621008	½" x ½" F
0121010	0921010	0621010	½" x ¾" F
0121011	0921011	0621011	¾" x ½" F
0121012	0921012	0621012	¾" x ¾" F
0121013	0921013	0621013	1" x ¾" F

NPT transition piece (female)
with hex-shaped threaded transition

Industrial brass Part no. (NPT)	Stainless steel Part no. (NPT)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x thread type
0121108	-	0621108	½" x ½" F
0121110	-	0621110	½" x ¾" F
0121111	-	0621111	¾" x ½" F
0121112	-	0621112	¾" x ¾" F
0121113	-	0621113	1" x ¾" F
0121114	1121114	0621114	1" x 1" F
0121115	1121115	0621115	1 ¼" x 1" F
0121116	1121116	0621116	1 ¼" x 1 ¼" F
0121117	1121117	0621117	1 ½" x 1 ¼" F
0121118	1121118	0621118	1 ½" x 1 ½" F
0121119	1121119	0621119	2" x 1 ½" F
0121120	-	0621120	2" x 2" F
0121122	-	0621122	2 ½" x 2" F

Transition piece
round (male)

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x thread type
0121208	0921208	0621208	½" x ½" M
0121210	0921210	0621210	½" x ¾" M
0121211	0921211	0621211	¾" x ½" M
0121212	0921212	0621212	¾" x ¾" M
0121213	0921213	0621213	1" x ¾" M

NPT transition piece (male)
hex-shaped threaded transition

Industrial brass Part no. (NPT)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x thread
0121308	0621308	½" x ½" M
0121310	0621310	½" x ¾"M
0121312	0621312	¾" x ¾" M
0121314	0621314	1" x 1" M
0121316	0621316	1" x 1 ¼" M
0121317	0621317	1 ¼" x 1" M
0121318	0621318	1 ¼" x 1 ¼" M
0121319	0621319	1 ½" x 1 ¼" M
0121320	0621320	1 ½" x 1 ½" M
0121321	0621321	2" x 1 ½" M
0121322	0621322	2" x 2" M
0121323	0621323	2 ½" x 2" M
0121324	0621324	2 ½" x 2 ½" M
0121325	0621325	3" x 3" M
0121327	0621327	3 ½" x 4" M

NPT transition elbow (female)

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x Thread type
0123008	0923008	0623008	½" x ¾" F
0123010	0923010	0623010	½" x ½" F
0123012	0923012	0623012	¾" x ¾" F
0123014	0923014	0623014	¾" x ½" F
0123016	0923016	0623016	1" x ¾" F
	(NPT)		
0123018	1123018	0623018	1" x 1" F

NPT transition street elbow (male/female)

Industrial brass Part no. (NPT)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x Thread type
0123208	0623208	½" x ½" F

NPT transition tee
(male)

Industrial brass Part no. (NPT)	Lead-free (potable) brass Part no. (NPT)	Dimension ND
0125506	0625506	½" x ½" M x ½"

Draining branch
to weld in valves

Industrial brass Part no.	Dimension ND
0041408	½"
0041410	¾"
0041412	1"
0041414	1 ¼"
0041416	1 ½"
0041418	2"

Flow meter well
May also be used for thermometer well.

Lead-free (potable) brass Part no.	Dimension ND
0628480	2 to 2 ½" x 1 ¼" x 1 ¼" F
0628500	4" x 1 ½" x 1 ½" F
0628520	4" to 6" x 2" x 2" F

Stub out
(PP-R to copper)

Part no.	Dimension ND
AQ630P248E	½"
AQ630P368E	¾"
AQ630P41110	1"

Straight stub out
(PP-R to copper)

Part no.	Dimension ND
AQ638P211	½"
AQ638P311	¾"
AQ638P418	1"

PEX adaptor (crimp)

ASTM F1807 standard with PP-R socket connection.

Lead-free (potable) brass Part no.	Dimension ND
0099840	½″ (20 mm) PP-R to ½″ PEX
0099841	¾″ (25 mm) PP-R to ¾″ PEX
0099842	1″ (32 mm) PP-R to 1″ PEX

PEX adaptor (expansion)

ASTM F1960 standard with PP-R street connection.

Lead-free (potable) brass Part no.	Dimension ND
0098840	½″ (20 mm) PP-R to ½″ PEX
0098841	¾″ (25 mm) PP-R to ¾″ PEX
0098842	1″ (32 mm) PP-R to 1″ PEX

PP-R to grooved transition

Lead-free (potable) brass Part no.	Dimension ND
0627060	2 ½″ (75 mm) PP-R to 2″ grooved

Transition elbow (male)

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R ND x thread type
0123506	0923506	0623506	½″ x ½″ M
0123508	0923508	0623508	½″ x ¾″ M
0123510	0923510	0623510	¾″ x ¾″ M
0123512	0923512	0623512	1″ x ¾″ M
0123514	-	0623514	1″ x 1″ M

Transition tee (female)

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension PP-R (ND) x thread type
0125006	0925006	0625006	½″ x ½″ x ½″ F
0125008	0925008	0625008	½″ x ½″ x ¾″ F
0125010	0925010	0625010	¾″ x ¾″ x ½″ F
0125012	0925012	0625012	¾″ x ¾″ x ¾″ F
0125014	0925014	0625014	1″ x 1″ x ¾″ F
	(NPT)		
0125016	1125016	0625016	1″ x 1″ x 1″ F
0125022	-	0625022	1 ½″ x 1 ½″ x 1″ F

NPT fusion outlet hex (female)

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension pipe x outlet (thread)
0128214	0928214	0628214	1 ¼" x ¾" (½" F)
0128216	0928216	0628216	1 ½" x ¾" (½" F)
0128218	0928218	0628218	2" x ¾" (½" F)
0128220	0928220	0628220	2 ½" x ¾" (½" F)
0128222	0928222	0628222	3" x ¾" (½" F)
0128224	0928224	0628224	3 ½" x ¾" (½" F)
0128226	0928226	0628226	4" x ¾" (½" F)
0128230	0928230	0628230	6" x ¾" (½" F)
0128232	0928232	0628232	8 to 10" x ¾" (½" F)
0128234	0928234	0628234	1 ¼" x ¾" (¾" F)
0128236	0928236	0628236	1 ½" x ¾" (¾" F)
0128238	0928238	0628238	2" x ¾" (¾" F)
0128240	0928240	0628240	2 ½" x ¾" (¾" F)

NPT fusion outlet hex (female) *(continued)*

Industrial brass Part no. (NPT)	Stainless steel Part no. (ISO)	Lead-free (potable) brass Part no. (NPT)	Dimension pipe x outlet (thread)
0128242	0928242	0628242	3" x ¾" (¾" F)
0128244	0928244	0628244	3 ½" x ¾" (¾" F)
0128246	0928246	0628246	4" x ¾" (¾" F)
0128250	0928250	0628250	6" x ¾" (¾" F)
0128254	0928254	0628254	8 to 10" x ¾" (¾" F)
	(NPT)		
0128260	1128260	0628260	2 ½" x 1" (1" F)
0128262	1128262	0628262	3" x 1" (1" F)
0128264	1128264	0628264	3 ½" x 1" (1" F)
0128266	1128266	0628266	4" x 1" (1" F)
0128270	1128270	0628270	6" x 1" (1" F)
0128274	1128274	0628274	8 to 10" x 1" (1" F)

NPT fusion outlet (male)

Industrial brass Part no. (NPT)	Lead-free (potable) brass Part no. (NPT)	Dimension pipe x outlet (thread)
0128314	0628314	1 " x ¾" (½" M)
0128316	0628316	1 ½" x ¾" (½" M)
0128318	0628318	2" x ¾" (½" M)
0128320	0628320	2 ½" x ¾" (½" M)
0128322	0628322	3" x ¾" (½" M)
0128324	0628324	3 ½" x ¾" (½" M)

Industrial brass Part no. (NPT)	Lead-free (potable) brass Part no. (NPT)	Dimension pipe x outlet (thread)
0128326	0628326	4" x ¾" (½" M)
0128330	0628330	6" x ¾" (½" M)
0128334	0628334	1 " x ¾" (¾" M)
0128336	0628336	1 ½" x ¾" (¾" M)
0128338	0628338	2" x ¾" (¾" M)
0128340	0628340	2 ½" x ¾" (¾" M)
0128342	0628342	3" x ¾" (¾" M)
0128344	0628344	3 ½" x ¾" (¾" M)
0128346	0628346	4" x ¾" (¾" M)
0128350	0628350	6" x ¾" (¾" M)

Distribution block plumbing
including 1 plug and 2 fasteners

Part no.	Dimension ND
0130115	¾" x ½"

Distribution block plumbing
with insulation block

Part no.	Dimension ND
0130130	¾" x ½"

Distribution pipe

Part no.	Dimension ND
0130604	1" x ½"

Distributor end piece
with female thread NPT

Industrial brass Part no.	Dimension (ND) x Thread
0130804	1″ x ½″ F

Screw-down stop globe valve
for surface installation

Industrial brass Part no.	Dimension ND
0140808	½″
0140810	¾″
0140812	1″
0140814	1 ¼″

Not for potable applications

Concealed valve (short)
chromium-plated,
tamper proof

Industrial brass Part no.	Dimension ND
0140868	½″
0140870	¾″
0140872	1″

Not for potable applications

Concealed valve (standard length)
chromium-plated, tamper proof

Industrial brass Part no.	Dimension ND
0140888	½″
0140890	¾″
0140892	1″

Not for potable applications

Concealed valve (extended)
chromium-plated

Industrial brass Part no.	Dimension ND
0140878	½″
0140880	¾″
0140882	1″

Not for potable applications

Concealed valve (standard)
chromium-plated,
tamper proof

Industrial brass Part no.	Dimension ND
0140858	½″
0140860	¾″
0140862	1″

Not for potable applications

Concealed valve
chromium-plated for
part no. 0040858-0040862

Part no.	Dimension ND
0040900	Length = 3.2″
0040902	Length = 4.25″

Stop valve body ISO

Industrial brass Part no.	Dimension PP-R (ND) x Thread
0040908	½″ x ¾″F
0040910	¾″ x ¾″F
0040912	1″ x 1″F
0040914	1 ¼″ x 1 ¼″F

Inclined valve
without drain

Industrial brass Part no.	Dimension ND
0041108	½″
0041110	¾″
0041112	1″
0041114	1 ¼″

Not for potable applications

Inclined check valve
without drain

Industrial brass Part no.	Dimension ND
0041208	½″
0041210	¾″
0041212	1″
0041214	1 ¼″

Not for potable applications

Ball valve
without drain

Industrial brass Part no.	Dimension ND
0041308	½″
0041310	¾″
0041312	1″
0041314	1 ¼″
0041316	1 ½″
0041318	2″

Replacement parts available
Not for potable applications

Ball valve
(male/female)

Industrial brass Part no.	Dimension ND
0078000	1″ — M/F

Replacement parts available
Not for potable applications

Ball valve
polypropylene

Part no.	Dimension ND
0041488	½"
0041588[a]	½"
0041490	¾"
0041590[a]	¾"
0041492	1"
0041592[a]	1"
0041494	1 ¼"
0041594[a]	1 ¼"
0041496	1 ½"
0041596[a]	1 ½"
0041498	2"
0041598[a]	2"
0041400	2 ½"

[a]Part comes with FKM/FPM O-ring in the color gray.

Ball valve
Polypropylene with ISO bolt pattern

Part no.	Dimension ND
0041602	3"
0041702[a]	3"
0041604[b]	3 ½" and 4"
0041704[ab]	3 ½" and 4"
0041607	6"
0041707[a]	6"

Extension for ball valve

Part no.	Dimension ND x length
0041378	½" to ¾"
0041382	1" to 1 ¼"
0041386	1 ½" to 2"

0041378 suitable for part no. 0041308 / 0041310.
0041382 suitable for part no. 0041312 / 0041314.
0041386 suitable for part no. 0041316 / 0041318.

Repair plug

to close pipe holes up to 7/16" (repair stick part no. 0060600)

Part no.	Dimension
0060600	7/16" x ¼"

Temperature protective gloves

Part no.	Dimension
0050195	-

Welding heads

Part no.	Dimension
0050206	3/8"
0050208	½"
0050210	¾"
0050212	1"
0050214	1 ¼"
0050216	1 ½"
0050218	2"
0050220	2 ½"
0050222	3"
0050224	3 ½"
0050226	4"

Drill bit

for boring fusion outlet holes

Part no.	Dimension
0050940	½" & ¾" for pipes 1¼" - 6"
0050941	½" & ¾" for pipes 2" - 10"
0050942	1"
0050944	1 ¼"
0050946	1 ½"

[a]Only fits into a drill press that can accommodate a Morse Taper shank.

Part no.	Dimension
0050948	2"
0050950[a]	2 ½"
0050952[a]	3"
0050954[a]	3 ½"
0050956[a]	4"
0050958[a]	6"
0050960[a]	8"

Fusion outlet welding heads

Part no.	Dimension
0050614	1 ¼" x ½" & ¾"
0050616	1 ½" x ½" & ¾"
0050619	2" x ½" & ¾"
0050620	2" x 1"
0050623	2 ½" x ½" & ¾"
0050624	2 ½" x 1"
0050625	2 ½" x 1 ¼"
0050627	3" x ½" & ¾"
0050628	3" x 1"

Part no.	Dimension
0050629	3" x 1 ¼"
0050631	3 ½" x ½" & ¾"
0050632	3 ½" x 1"
0050634	3 ½" x 1 ¼"
0050635	3 ½" x 1 ½"
0050636	4" x ½" & ¾"
0050638	4" x 1"
0050640	4" x 1 ¼"
0050642	4" x 1 ½"
0050644	4" x 2"
0050648	6" x ½" & ¾"
0050650	6" x 1"
0050652	6" x 1 ¼"
0050654	6" x 1 ½"
0050656	6" x 2"

Part no.	Dimension
0050657	6" x 2 ½"
0050658	6" x 3"
0050660	8" x ½" & ¾"
0050662	8" x 1"
0050664	8" x 1 ¼"
0050666	8" x 1 ½"
0050667	8" x 2 ½"
0050668	8" x 2"
0050669	8" x 3"
0050670	8" x 3 ½"
0050671	8" x 4"
0050672	10" x ½" &. ¾"
0050674	10" x 1"
0050676	10" x 1 ¼"

Fusion outlet welding heads *(continued)*

Part no.	Dimension
0050678	10" x 1 ½"
0050680	10" x 2"
0050682	10" x 2 ½"
0050684	10" x 3"
0050686	10" x 3 ½"
0050688	10" x 4"
0050690	12" x 2"
0050692	12" x 2 ½"
0050694	12" x 3"

Part no.	Dimension
0050696	12" x 3 ½"
0050698	12" x 4"
0050699	12" x 6"
0050712	14"x 2"
0050714	14" x 2 ½"
0050716	14" x 3"
0050718	14" x 3 ½"
0050720	14" x 4"
0050722	14" x 6"
0050724	14" x 8"
0050726	16" - 24" x 2"
0050728	16" - 20" x 2 ½"
0050730	22" - 24" x 2 ½"
0050732	16" - 20" x 3"

Part no.	Dimension
0050734	22" - 24" x 3"
0050736	16" - 18" x 3 ½"
0050738	20" - 22" x 3 ½"
0050740	24" x 3 ½"
0050742	16" x 4"
0050744	18" - ½" x 4"
0050746	22" - 24" x 4"

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